JPRS 79781

4 January 1982

USSR Report

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

No. 59

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. JPRS 79781	2.	3. Recipient's Accession No.

4. Title and Subtitle	5. Report Date
USSR REPORT: CYBERNETICS, COMPUTERS, AND AUTOMATION TECHNOLOGY, No. 59	4 January 1982
	6.
7. Author(s)	8. Performing Organization Rept. No.
9. Performing Organization Name and Address Joint Publications Research Service 1000 North Glebe Road Arlington, Virginia 22201	10. Project/Task/Work Unit No.
	11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address As above	13. Type of Report & Period Covered
	14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The report contains articles, abstracts and news items on theory, design, development and application of analog and digital apparatus, elements and components of control systems, reliability and optimality, information theory, and the theory of automata.

17. Document Analysis a. Descriptors

USSR
Automation
Automata Theory
Information Theory
Computers
Computer Programming

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group 6D, 9B, 9D

18. Availability Statement:	19. Security Class (This Report)	21. No. of Pages
Unlimited Availability Sold by NTIS Springfield, Virginia 22161	UNCLASSIFIED	164
	20. Security Class (This Page) UNCLASSIFIED	22. Price

(See ANSI–Z39.18)

OPTIONAL FORM 272 (4–77)
(Formerly NTIS–35)
Department of Commerce

JPRS 79781

4 January 1982

USSR REPORT

Cybernetics, Computers and Automation Technology

No. 59

Contents

GENERAL

Unified Computer System CEMA Cooperation 1

ELORG Director Discusses Trade 3

Socioeconomic Problems of Production Control Automation on National Economic Scale 5

Computer Technology Economics 8

Optimization of Sector Plan for Establishing Automated Control Systems 19

Glushkov on Statewide Automated Data Collection and Processing System 35

HARDWARE

Third Generation Computers 37

A6401 Robotron 38

Future of Computer Hardware 39

New Measuring and Computing Complexes (MCC) Based on SM, CAMAC International Systems 41

Riga VEF Association Develops Outstanding Microcomputer System 48

Two-Processor Complex Passes Tests 50

Kubyshev Automated System Subdivisions Proving Efficient 52

 [III - USSR - 21C S&T]

Repair of Integrated Circuits 55

Sensory-Type Console for Operational Data Feeding to Graphic Display Unit. 56

New Bulgarian Office Computer Offered for Sale. 61

Computers Become Intellectual 63

Some Functions and Structures of Intelligent Information Form Converters. 66

Distinctive Features of Architecture and Structure of Problem-Oriented Basic Computer for Processing Data of Full-Scale Tests . . 75

Synthesis of Control Devices With Variable Time Diagrams. 83

APPLICATIONS

Automated Control System for Petrochemical Processes Working Well . . 97

Latvian SSR Administrative Rayon Automated Data Processing System . . 99

Tomsk Collective-Use Computing Center 101

Technology in Use and Comtemplated at CSA Computer Centers. 103

New Steps Toward Remote Data Processing in State Statistics System. . 106

Gosbank Gorkovskaya Oblast Office Computing Center Improvements Urged 114

Experience in Automating Planning and Financing of Scientific-Research and Experimental Design Work in Scientific Research Institutes. 123

Briefs
- Elektronika BZ-24G Minicalculator 132
- International Computer Network 132
- Computers in Central Heating Netowrk 132
- Computers at VAZ 133
- Computers in Accounting 133
- Computer Program at GOI 133
- Lasers in Highway Construction 134
- YeS-1055 Computer at KAMAZ 134
- Computers in Instrument Building and Automation 134
- Hardware Equipment in ASU 135

CONFERENCES AND EXHIBITIONS

Statements by Chief Designers of SM Computers 136

East German Computer Equipment in Minsk 138

All-Union Conference on Organization of Maintenance and Technical Servicing of Computer Equipment 140

Conference on Computer Networks 142

'Communications-81' : International Exhibit in Moscow 143

ORGANIZATIONS

Brief History of Yerevan Scientific Research Institute of Mathematical Machines 146

Dorodintsyn Praises Yerevan Scientific Research Institute of Mathematical Machines 149

Relations of Yerevan Scientific Research Institute of Mathematical Machines With Estonian Computer Center. 150

Personnel of Yerevan Scientific Research Institute of Mathematical Machines Praised. 151

PUBLICATIONS

Abstracts of Articles From Journal 'CONTROL SYSTEMS AND MACHINES', July-August 1981. 153

GENERAL

UNIFIED COMPUTER SYSTEM CEMA COOPERATION

Tallinn SOVETSKAYA ESTONIYA in Russian 29 Jul 81 p 3

[Article by V. Petrunya: "In the Unified System"]

[Excerpts] Specialists of five CEMA member countries began developing a standardized unified electronic component base for electronic equipment, communications devices and computer equipment. This work was supported by an intergovernmental agreement which was recently signed in Sofia at the 25th session of the CEMA meeting. Creation of this base will permit more complete satisfaction of the needs of fraternal countries for electronic articles of a high engineering level.

It was also decided to develop a program of cooperation directed toward extensive use of microprocessors in the national economy. This equipment is of great importance for increasing the effectiveness of economics and for acceleration of scientific and technical progress.

These agreements denote a qualitatively new phase of cooperation among CEMA member countries in an important socioeconomic field--an automation of labor in all spheres of activity of modern society. It is based on the solid experience of previous years accumulated by the socialist countries. Development of computers and ASU [Automated control systems] within the framework of CEMA is regarded as one of the strategic directions of the scientific and technical policy of the fraternal countries. More than 300,000 specialists and workers, which are working at more than 80 plants and companies, have been recruited to the sphere of cooperation in this field.

The CEMA countries are cooperating in development of computer equipment on the basis of specialization and cooperation of scientific research, design work and machine production. It is no accident that mutual deliveries of computers within CEMA countries are increasing continuously. The chairman of the CEMA committee on scientific and technical cooperation G. I. Marchuk called the creation of a scientific and production base for development and manufacture of computer equipment a really important result at the last meeting of the council.

CEMA member countries now essentially satisfy their own needs completely for modern computer equipment. They have stopped purchasing it in the capitalist countries and are acquiring only single models in individual cases.

This success is not only of scientific and economic significance. Cooperation in the field of development and use of computer equipment in the national economy is one of the important prerequisites for equilization of the economic and scientific and technical levels of development of fraternal countries.

One of the first American models of microprocessors, for example, is distinguished by small capacity and can perform 100,000 instructions per second. According to data of the CEMA Secretariat, the Elektronika NTs-80-01 microprocessor computer system with speed of 550,000 operations per second has been developed in the USSR. This small compact card weighs only 300 grams.

6521
CSO: 1863/240

ELORG DIRECTOR DISCUSSES TRADE

Moscow SOVIET EXPORT in English No 5, Sep-Oct 81 pp 2-5

[Roundtable discussion of the General Directors of Soviet trade organizations]

[Excerpt] Yu. D. Scherbina: In 1969 six socialist nations--the USSR, the GDR, Bulgaria, Czechoslovakia, Hungary, and Poland--concluded an intergovernmental agreement, later joined by Romania and Cuba, on cooperation in setting up a unified computer system (ESEVM). To implement the agreement a large number of research centres in the CMEA countries concerned developed and introduced in commercial production, in 1971, computers answering the specifications of the United System (ES EVM).

Now ELORG exports and imports the hardware of third-generation computers of the ES and SM (minicomputers) series, a joint product by electronics engineers of the socialist nations. Since the first Soviet-built computers began to be exported 18 years ago, their total has reached more than 700 units in 18 countries. With computer exports growing at a rate of 10% to 15% a year our trade has increased more than fourfold since 1970, when ELORG was established.

Soviet computers are used in the socialist countries, in India, Finland and Belgium. There are good prospects for supplying ES EVM computers to France and South-East Asia.

To meet Western European computer standards, ELORG has joined developers and manufacturers in a programme of design adaptation that has produced a hybrid unit employing foreign peripherals.

Now ELORG offers for export second-stage ES EVM virtual-memory computers--ES-1035, ES-1045, and ES-1060. Apart from that we are offering buyers new operating systems that afford higher computer efficiency at multiple-access centres and data banks.

Following a take-over of commercial operations from V/O TECHMASHEXPORT in 1979, ELORG started exporting minicomputers of the SM EVM Series--SM-1, SM-2, SM-3 and SM-4 which have an operating speed of 200,000 to 500,000 short operations per second.

To assure efficient operation of Soviet computers ELORG has set up maintenance assisting centres in Bulgaria, Czechoslovakia, the GDR, Hungary, Poland and India. We also cooperate with the joint-stock companies Elorg-Data in Finland and Elorg in Belgium.

As many as 1,100 foreign computer specialists are trained in the USSR annually.

Because of the commercial success of Elorg-Data our organisation has good relations with many Finnish companies. Elorg-Data has set up a multiple-access centre of two ES-1022 and one ES-1035 computers for rendering data processing services. This is one of the largest centres of its kind in Finland, with about 80 reputable clients.

We have contracted to supply six Finnish companies with Unified System computers complete with Soviet-developed software adapted to customers' needs. Similar work is being started in France, following a recent Franco-Soviet agreement on cooperation in the computer technology. ELORG will be actively involved in translating this agreement into reality.

Our exports are not confined to computers. We sell microcalculators, cash registers, integrated circuits, semiconductor instruments, vacuum tubes and other electronic products and components.

The Soviet electronic industry ranks among the world's largest producers in the field. The high quality of Soviet-made products ensures them a steadily growing demand in the international market. Since 1971 their exports have gone up 8 times.

Yu. D. Scherbina, general director, V/O ELECTRONORGTECHNICA (ELORG)

CSO: 1863/28-E

SOCIOECONOMIC PROBLEMS OF PRODUCTION CONTROL AUTOMATION ON NATIONAL ECONOMIC SCALE

Moscow EKONOMICHESKIYE NAUKI in Russian No 7, Jul 81 pp 39-47

[Article by Yu. Komarnitskiy, doctor of economic science, Yu. Mikheyev, candidate of engineering science, A. Frolov, candidate of physicomathematical science, and V. Bondarev, in the section "Economic Laws and the Socialist Economy"]

[Excerpt] Automated control systems are being developed and, based on them, the state-wide automated control system is being formed in accordance with CPSU policy which calls for fundamental improvement in the system of accounting, planning and management and for further improvement in the economic mechanism as a whole. The "Main Directions of Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990," adopted by the 26th party congress, outline further development of work in the field of automating control of social production and uniting automated control systems and shared computer centers into a single state-wide system.[1]

Solving this exceptionally complex and multifaceted problem, extremely important to further development of our economy and fuller satisfaction of worker demands, requires serious attention from political economists. The necessity has become ripe for deep theoretical grounding and analysis based on Marxist-Leninist methodology of the complex of economic phenomena and processes associated with the establishment and development of automated control systems and the State-Wide Automated System of Information Acquisition and Processing for Accounting, Planning and Management of the National Economy (OGAS). Of special importance are the politicoeconomic comprehension and solution of the problems of social production control automation. Without the participation of politicoeconomic science, it is not possible to fully bring out the objective prerequisites for forming the OGAS at the stage of mature socialism and to disclose and comprehensively make use of the possibilities that this system yields for improving the complex of socioeconomic processes now and in future.

The Department of Political Economy at the Moscow Aviation Institute has been drawn into the socioeconomic studies concerning OGAS being conducted at the All-Union Scientific Research Institute of Organization and Control Problems (VNIIPOU). The department collective has set itself the goal of undertaking the first steps in the field of politicoeconomic study of the problems of establishing and subsequently using the OGAS. Studies have been carried out jointly with scientists of the

---

1 See: Materials of the 26th CPSU Congress, Moscow, 1981, p 201.

VNIIPOU, drawing on the scientific staff developed within the framework of systems research. This work is new not only from the aspect of the specifics of the object under investigation, but also in an organizational sense since it provides for permanent and extensive scientific contacts between the VUZ Department of Political Economy and the research collectives active in the field of engineering and natural sciences. At present, one can speak of results of only the initial phase of this large joint effort. A number of basic elements of the politicoeconomic grounding of OGAS has been isolated: establishment and development of OGAS—the main direction of the process of automating management of social production; the capabilities the system yields for more complete and efficient use of economic laws in managing the unified national economic complex; and the discovery of the main trends in improving the management of socioeconomic processes under the conditions of OGAS and certain other items.

The aim of this article is to familiarize the reader with the initial results of the work carried out in the new direction of politicoeconomic research. Mention should be made first of all of the considerable results of measures already implemented in our country on the course to establishing the automated system to manage the national economy. More than 4,000 automated systems for management of departments and ministries, republics and oblasts, associations and enterprises (ASU), automated process control systems (ASUTP) and automated information processing systems for various purposes have been set up and incorporated directly into the process of social production. Just in the last year of the 10th Five-Year Plan, 520 ASU's, including 380 ASUTP's, were introduced. We are developing the methodology and beginning to work out in practice the interaction of ASU's for state-wide management agencies, primarily the automated system for plan calculations (ASPR) of the USSR Gosplan with the USSR TsSU [Central Statistical Agency] automated system for state statistics (ASGS), and the ASGS with the automated system for management of science and technology (ASUNT). The ASPR second phase, a major OGAS subsystem, must be put into operation in the 11th Five-Year Plan in accordance with the 12 July 1979 decree by the CPSU Central Committee and the USSR Council of Ministers. Politicoeconomic research must rest primarily on the experience already gained in the functioning of various ASU's and computer centers. At the same time, the significance of the qualitative leap from the functioning of individual automated systems for managing sectors, departments and certain economic and administrative activities to the OGAS unified on the scale of the entire country can be presented most completely precisely from politicoeconomic positions. OGAS is a qualitatively new, not simply engineering, but socioeconomic stage in the evolution of managing the socialist economy. Since the latter is based on public socialist ownership and since it has now been formed as a unified national economic complex directed by a unified plan for economic and social development, an automated management system meets fully the needs of the economic basis only when it embraces the country's entire economic activity. At that stage, i.e. when OGAS is entirely formed, this system will fully bring out all the advantages associated with its use. The politicoeconomic approach to the development of OGAS, consequently, aims at seeing that all progress made in introducing and applying automated management systems is considered a step in the advancement in the unified main direction of forming the OGAS. It goes without saying that in the process it is extremely important to bring out and make use of all those significant economic and social advantages that are revealed in the mature socialist society with the introduction of each relatively "partial" automated management system and with the commissioning of each relatively "local" computer center. Efforts are actively underway to establish organizational-technological ASU's--integrated systems that

ensure a functioning of ASUP's, ASUTP's and other ASU's in industrial enterprises and associations that is coordinated by goals, criteria and data processing procedures. One of every four production associations is now equipped with an automated management system. Republic ASU's are being established in all union republics. Seven shared computer centers, the base for the State Network of Computer centers (GSVTs), have been placed into operation. A number of guidance materials and standard design solutions for establishing new links of the OGAS has been developed and implemented.

Measures now being implemented to improve planning and strengthen the influence of the economic mechanism on increasing production efficiency and work quality are linked directly with the establishment and practical use of automated systems for management and processing of information at all levels of the national economy. Further development of ASU's is determined primarily by the needs of the practice of building communism and by new requirements on the system of planning and management: by increasing the comprehensiveness of national economic planning, by the need for deeper analysis and more precise forecasting of social needs, by extending the time plan horizon based on the Comprehensive Program of Scientific and Technical Progress for 20 Years, by employing target program methods, by improving the economic methods of planning and by rearranging organizational structures. The main way to solve these problems, socioeconomic in their nature, is by integrating ASU's, establishing the State-Wide Automated System of Information Acquisition and Processing for Accounting, Planning and Management of the National Economy (OGAS) based on the State Network of Computer Centers and the Unified Automated Communications Network for the country.

Informational interaction between management agencies at all levels has always been a major process in administrative activity and a necessary condition for the normal functioning and development of the social organism. Expedient actions of the interrelated participants of the production process are not possible without the creation, transmission and processing of information. Establishing and developing automated management systems and integrating them on a unified organizational, methodological and engineering basis into the OGAS is the main direction of improving the organization of informational processes in social production under contemporary conditions. The potential capabilities of ASU's are not now being realized to the full extent; this pertains especially to the interaction of systems and integration of their functions. The reason for this is not only in the technological and technical complexity of automating management processes. The cause is primarily in the certain underestimation of the socioeconomic aspects of automating management of social production, and in the fact that the problems of establishing the OGAS and making use of the ASU's and computer centers that already exist are still often treated by scientific and economic workers as only engineering or technical-economic. Their enormous socioeconomic importance is uderestimated, and this weakens the attention to this problem, which, naturally, in no way promotes high rates in solving it and fuller use of the capabilities arising in connection with this.

8545
CSO: 1863/254

COMPUTER TECHNOLOGY ECONOMICS

Moscow EKONOMIKA VYCHISLITEL'NOY TEKHNIKI (NOVOYE V ZHIZNI, NAUKE, TEKHNIKE: SERIYA "NAUKA I TEKHNIKA UPRAVLENIYA") in Russian No 9, Sep 81 (signed to press 17 Aug 81) pp 1-64

[From book "Computer Technology Economics (Innovations in Living, Science and Technology: 'Control Science and Engineering' Series)", by Lyudmila Dmitriyevna Abramova, candidate of economic sciences and assistant, Economic Cybernetics Department, Moscow Control Institute imeni S. Ordzhonikidze, Izdatel'stvo "Znaniye", 29,590 copies, 64 pages]

[Excerpts] The Volga Motor Vehicle Plant has one of the best ASU's [automated control systems] in the country. A new document circulation system has been developed here. Real-time calendar planning and an hour-by-hour check of progress in the production of 8300 parts and units and record keeping of the flow of 4500 different kinds of materials and components are accomplished at the plant on the basis of a computer. Calculations are performed on the labor and wages of 80,000 workers, scientific and technical personnel and office workers for 72 kinds of schedules and tasks are implemented relating to the repair and servicing of 23,000 pieces of equipment. The shipment within the USSR and abroad of more than 3500 different kinds of spare parts for motor vehicles is planned and distributed over 300 points in a centralized manner.

An effective trend has been the creation of an OASU [automated control system for a sector of industry] with an increasing number of subsystems making it possible to solve a broad range of large effective planning and control objectives. Able to be considered the most developed among them is the ASU of the USSR Ministry of Instrument Making, Automation Equipment and Control Systems, including 20 subsystems including such fundamentally new ones as control of planning and capital construction and product quality, improvement of management organization, longterm planning and distribution of production. Introduction of this system to the full extent made it possible not only to reduce substantially all key components of production costs in the industry, but also to increase considerably the rate of growth of labor productivity and of the output of industrial products. An average increase of 3.5 percent in the output of products in recent years has been achieved in the industry only as the result of calculations of optimum plans.

ASU's have been introduced at enterprises of this ministry, which produce about 85 percent of the industrywide total output of products.

An analysis has demonstrated that the demand for control and general-purpose computers is still far from being totally satisfied. Computing centers, of which there are more than 3000 in the country, are still inadequately furnished with peripheral equipment, a shortage of data transmission equipment is being felt, and things are not going well with operating materials (paper and magnetic information media, etc.).

These and other shortcomings (the unprepared state of tasks among users, the unadapted state of space and the like) have been hindering the effective employment of computer technology and in particular have resulted in the fact that the mean utilization of computers in the country equals about 12 h per 24-h period instead of 18 to 20 h.

In spite of these shortcomings the effectiveness of capital investment in computer technology and ASU's is greater than for other lines of investment. At one time a standard effectiveness factor of 0.3 was established for capital investment for the creation of ASU's, i.e., the return from each ruble of capital investment was to equal not less than 30 kopecks per year. This factor was specified also in the last five-year plan period. Actually for the national economy as a whole it equaled 0.4 to 0.42 and for individual sectors of the national economy it reached values of 0.5 and even 0.6.

In the 10th Five-Year Plan period, according to calculations of the combined computer technology division and industry divisions of the USSR Gosplan, for the national economy as a whole outlays for ASU's and computer technology were recovered in 2 to 2.5 years, corresponding to a capital investment recovery factor of 0.4 to 0.5.

On the whole the recovery period for capital invested in the development of ASU's as a rule is not greater than 3 to 3.5 years, ASUTP's [automated control systems for technological processes] are paid back in 1 to 1.2 years and ASUP's [automated control systems for enterprises] are paid back in 2.5 years. In a relatively brief period as the result of the introduction of ASU's in the national economy more than 10 billion rubles have been gained, including 3.4 billion rubles during the years of the 10th Five-Year Plan period, and the growth of national income (taking into account the indirect savings) has equaled respectively 5.8 and 6.7 percent of its total growth, including 3.2 percent in the form of an added savings on account of the lowering of production costs and more than 3.5 percent in the form of an added growth in production.

A short recovery period and a considerable savings are characteristic of ASU's of the most popular class at the present time--ASUP's. For example, the introduction of the "Sigma" ASU at the Novosibirsk "Elektrosignal" Plant was recovered in 3.1 years. At the Barnaul Mechanical Equipment Plant introduction began in February 1977 and in September of the same year the system was accepted for experimental use with a savings of 275,700 rubles and a recovery period of 1.96 years. At an agricultural machine building plant (in Frunze) a "Sigma" system was put into industrial service in approximately seven months with a total savings of 601,900 rubles.

The time for introducing the "Sigma" system and other standard ASU's and the indicators of the annual savings were approximately the same with their introduction at

dozens of other industrial enterprises. However, examples of substantially longer periods for the introduction of systems are also known.

The advantages of ASU's and their high effectiveness are obvious. On the other hand they are still not being utilized to the full extent. It is not just a question of the fact that the best models and the performance figures of the leading ASU's have still not become generally widespread and have not become the everyday standard. There is a great potential for improving the effectiveness of ASU's.

The Unified System for the Classification and Coding of Technical and Economic Information (YeSKK) and unified documentation systems (USD's) are being developed and introduced in practice for controlling the national economy for this purpose.

Within the framework of the YeSKK all-Union classifiers are being put into effect--unique dictionaries of a unified man-machine language in which the appropriate information is systematized and presented in digital form.

Phase one of the YeSKK includes 19 all-Union classifiers, including for industrial and agricultural production, jobs and services in industry, trades of workers and positions of office personnel, structural units of the national economy, entities of the administrative-territorial division of the country and certain others.

Unified documentation systems include the Unified System of Design Documentation (YeSKD) and Unified System of Technological Documentation (YeSTD), the system of design and technological classification and coding and microfilming and automated design systems. The introduction of these systems shortens severalfold the time required for the development and mastery of new equipment, lowers almost tenfold costs of design preparation and improves the quality of products produced.

For example, the designing of a system at the Krasniy Proletariy [Red Proletarian] Plant was based on the extensive employment of all-Union classifiers (for industrial and agricultural production, for a system of designations of units of measurement employed in an automated control system, for information on personnel, trades of workers, job positions of office workers and rate categories), as well as of unified systems for primary accounting, reporting and statistical and other documentation.

All-Union production classifier codes are used in solving key problems in subsystems for real-time accounting of the flow of physical assets, for supplies, marketing and design and technological preparation for production.

The all-Union classifier (OK) of information on personnel, the unified system of primary accounting documentation, the system of arrangement and organization documentation, the YeSKD and YeSTD were used in solving problems associated with production control.

The introduction of industrywide classifiers of technical and economic information and a USD with the processing and retrieval of digital information on a computer made it possible to specialize the data and to increase the speed of data processing by 20 percent. The annual savings from the introduction of the enterprise ASU taking into account the use of an OK for technical and economic information and a USD has equaled about 700,000 rubles.

Unfortunately, cases are still encountered in which various scientific institutions located in the same rayon or oblast develop studies on closely related or even similar topics, duplicate their work and scatter their forces. The application of computer technology and the development and introduction of ASU's is an example of such non-thorough utilization of scientific and technical potential. Institutions of the Siberian Division of the USSR Academy of Sciences, of the Ministry of Instrument Making, Automation Equipment and Control Systems and of the radio industry and dozens of other institutions are involved in the development of ASU's in Novosibirskaya Oblast, for example.

The party oblast committee has been actively influencing the choice of subject matter, the planning of scientific research and the obtainment of final results by means of a council for the promotion of the scientific and technical and social and economic development of the oblast. This interdepartmental territorial public organization, working under the auspices of the CPSU obkom, has been assigned the job of coordinating the development of a program of scientific and planning and design work and of putting this work into service in the national economy. The council offers wide opportunities for cooperation between scientists and specialists regardless of their departmental jurisdiction.

The people in Leningrad have done even more. They have developed within the overall plan for economic and social development a special-purpose overall program for the creation of an ASU for Leningrad and Leningrad Oblast for 1981-1990. The people of Leningrad have explained the need to develop such a program by the importance of planning and controlling the performance of work, of ensuring managerial-aid and scientific methodological unity, of intelligently allocating computer equipment in the territorial-industrial aspect, of improving the technology and quality of systems created, of generalizing and disseminating advanced know-how and of reducing the time required for and the cost of creating ASU's.

The main guidelines for the implementation of this special-purpose program call for the following:

The carrying out of scientific research and design work relating to solving general-system problems in the development and functioning of the ASU complex for Leningrad and Leningrad Oblast.

The creation and introduction of functional control complexes and key components of the ASU complex.

The development of ASU's in the industrial and urban management sectors and in transportation and at the USSR Academy of Sciences Northwest Science Center.

The carrying out of measures relating to personnel support for work relating to the creation and functioning of ASU's and to ensuring the national economic effectiveness of the ASU's for Leningrad and Leningrad Oblast.

The goals of the special-purpose program for the five-year plan period have been specified in the coordination plan for the introduction of ASU's, which calls for increasing the number of existing ASU's 2.5-fold, obtaining a savings from the introduction of ASU's to the tune of 217 million rubles, increasing the number of

computing centers 1.6-fold and the inventory of medium- and high-capacity computers 2.8-fold, and of training and retraining 29,000 specialists in the field of control methods and equipment.

A typical ARM [automated work site] includes the following pieces of equipment in its structure: an SM-3 (or M-400) computer, an IZOT-1370 magnetic disk storage, an AP-5080 magnetic tape storage, punched tape input units, an AP-6100 punched card input unit, a "Videoton-340" alphanumeric display, an operator's console based on an electric typewriter or display, an EPG-400 graphic display with a light pen, an AP-7252 graph plotter, an EM-709 graphic information coder, an interface for a higher-level computer (a YeS [Unified Series] computer or M-4030) and a DGM-180 printer.

In existing systems for designing printed circuit boards implemented with M-4030, BESM-6 and YeS computers, a number of problems must be solved manually (correction of results obtained on the computer and the designing of individual types of boards the design and fabrication technology of which do not meet the requirements of the system). Besides, a large computer and additional peripheral equipment are required for introducing the system, which can prove to be economically unfeasible with a small amount of design work. These jobs, both together with the design system and independently, can be performed by means of an ARM-R [automated work site for radio electronic design] complex. When using a design system based on a small computer the results can be read out onto the screen of a display and be improved further: Connections, junctions, etc., can be added and erased by means of a light pen. Then the drawing is read out to a graph plotter and punched tape for the purpose of producing a mask on a special piece of equipment. In manual designing it is possible to read out from a coder onto a magnetic disk descriptions of printed circuit boards and elements, after which it is possible to lay out a specific circuit on the screen by means of a keyboard and light pen. When elements have been established by means of the light pen connections are added. These problems are solved by standard applied programs of the ARM-R complex.

An analysis of existing ASUTP's has demonstrated that the average recovery period for systems is a total of 1.42 years, whereas this indicator equals 3.3 years for ASUP's, for example.

The high effectiveness of ASUTP's is determined primarily by intensification of production processes, by the output of additional products (by two to seven percent), by an increase in the output-capital ratio (two to five percent) and by a reduction in input of physical resources (two to four percent). The experience of operating many automated systems has confirmed this. For example, the use of automatic units for the location and spacing of blanks on 19 rolling mills of metallurgical plants has made it possible to increase the output of good rolled products by 181,200 tons. Enterprises which have introduced ASUTP's have obtained in a year an additional profit to the tune of 3.2 million rubles with a total input of 3.6 million rubles for the creation of the systems. At four chemical plants the introduction of ASUTP's produced an added profit to the tune of 600,000 rubles with an input of 1.2 million rubles. At the Ryazan' and Barnaul chemical fiber combines the changeover of control of the operation of settling baths to the automatic mode has made possible an annual savings of 135,000 rubles with an input of 110,000 rubles for the creation of the systems.

The ASU for technological processes in operation at the Alumina Combine imeni the 50th Anniversary of the USSR--the head enterprise of the Glinozem [Alumina] Association (in Pikalevo, Leningrad Oblast)--has evoked great interest. Created on the basis of two M-6000 computers, the system accomplishes optimum control of the technological processes of producing a nepheline-lime mixture, alumina, soda, portland cement and other products. The savings from introducing the "Nefelin" [Nepheline] ASU has exceeded 2 million rubles with an input of 3.2 million rubles for creation of the system. More than 200 people have been relieved in sections. Operating round the clock, the control system makes possible the accident-free operation of equipment, protecting from disorganization and production spurts.

The use of microcomputers has reached the greatest scale in machine building, in particular, in machine tools with numerical program control. In 1981 more than 2500 machine tools with microelectronic control will be produced and their number is to increase dozens of times during the entire 11th Five-Year Plan period. A microcomputer lowers the cost of a system for controlling a single machine tool by 10,000 rubles on average, improves the reliability of equipment considerably and reduces the need for production space.

In the creation of automatic telephone exchanges microcomputers make it possible to lower the cost of communications equipment 1.5-fold, to reduce the consumption of electric power approximately threefold and to improve considerably the reliability and carrying capacity of telephone lines. By automating certain operations relating to controlling the engine, transmission and brakes of an automobile, microprocessors are conducive to raising the economic efficiency of an engine by 10 to 15 percent and to reducing the toxicity of exhaust gases.

The YeS-9001 and SPD-9000 units for preparing data on magnetic tape have been developed in our country and are being series produced. A calculation of the economic efficiency of using just one SPD-9000 data preparation system (the system replaces one tabulator, two sorters, 14 punches and 34 adding machines) demonstrates that the total annual savings equals 37,400 rubles and by using it five million punched cards are saved per year.

Systems of the SPD-9000 type are being installed at computing centers. The unit cost of a single work site is reduced with an increase in the number of operator consoles connected, since the major cost of the system is due to the M-6000 computer. If the system is used with a small number of consoles, i.e., its capacity is underutilized, then the M-6000 can in addition accomplish the independent processing of data.

It must be emphasized that the use of such promising units as magnetic disk storages and, in particular, floppy disks, makes it possible to gain the following advantages over traditional peripheral equipment:

In view of their multiple use, the relative cost of floppy disks is approximately 70-fold lower than the cost of punched card equipment.

The speed of the input of information into a computer from a magnetic disk is 30-fold greater than the speed of inputing from punched cards.

The productivity of the operator, because of the high technical parameters of the equipment, is 20 percent greater than the productivity of a puncher (productivity is increased 40 percent when using a data display unit).

The multifunctional nature of the unit reduces the list of peripheral equipment and increases the efficiency of its utilization.

A multiconsole system for the non-punch input of data designed for automating the most labor-intensive processes--the preparation of information for entry into a YeS [Unified Series] computer--based on YeS-7168 displays makes it possible to prepare data in real time from 32 work sites.

The system makes it possible to increase the labor productivity of operators by 10 to 60 percent, to increase the reliability of information by 20 to 100 percent, to increase 50-fold the speed of the input of information into a computer, and to increase threefold the efficiency of the processing of information at a computing center.

Questionnaire surveys conducted at computing centers of the USSR Central Statistical Administration system have shown that the actual labor intensiveness of data processing is on average 29 percent higher than that called for by standard projects and the cost is 25 percent higher. Furthermore, in terms of labor and wages at industrial enterprises the labor intensiveness is 21 percent higher and the cost 25 percent, and in terms of materials 37 and 26 percent, respectively.

On average the total underutilization of equipment at investigated republic computing centers of the USSR Central Statistical Administration system is greater than 30 percent; consequently, it can be assumed that possibilities exist for increasing the extent of services by more than 30 percent upon condition of the total utilization of the computer inventory, without additional capital investment. Furthermore, the reduction in production costs (because of the reduction in the percentage of the hypothetically constant portion of costs) will make it possible to increase profits and the profitability of the operation of a computing center.

It is also possible to increase the utilization of computing equipment by the extensive employment of the multiprogram processing mode, which at the present time is the basic operating mode of computers with a speed of 50,000 operations per second and more. At the same time with the still encountered single-program mode the idle time of a computer is rather long. For example, with a computer speed of up to 100,000 operations per second the idle time of the processor, the most expensive part of the computer, can equal 40 to 50 percent and more. Furthermore, with an increase in the speed of a computer the idle time of the processor is increased and with a speed on the order of one million operations per second can reach 80 to 90 percent.

Another no less important path toward improving the effectiveness of the utilization of a computer is the maximum development of the complete centralized servicing of computing equipment.

Now enterprises which have computing centers not infrequently perform the servicing of computers independently by means of the manpower of their own specialists. Is this justified? Of course not. Under the situation in which the computer

inventory is growing it is impossible to act amateurishly; centralized servicing and repair are necessary. And there are all the prerequisites for this in large industrial centers. In Leningrad, for example, more than 200 computing centers are in operation at scientific research institutes and industrial enterprises, in which they number more than 500 computers of different models.

On the other hand, with round the clock operation each large computer is serviced by 10 specialists on average. Thus, a total of about 5000 people are required in Leningrad. However, these highly skilled personnel are occupied for the entire day; the equipment needs preventive maintenance once every 12 to 15 days. Forty crews of five to seven people each could manage the entire amount of work with the centralized servicing of computers. Compare 300 and 5000. Estimates have demonstrated that in the immediate years to come the centralized organization of the installation, debugging and servicing of computers on the countrywide scale would produce a savings equivalent to reducing the number or personnel servicing computing equipment by 50,000 to 80,000 persons. It is possible to save many millions of rubles as the result of centralization and the stockpiling and utilization of spare parts and service equipment.

The unit cost of an individually developed program is approximately 4 to 5 rubles and Tsentrprogrammsistem [association in Kalinin] sells programs at the rate of 3.8 kopecks per machine instruction for third-generation computers.

The question of creating a flowline production process for programming was at the center of attention of the First All-Union Conference on Programming Technology which convened in Kiev (1979). Representatives of practically all major organizations of the country which develop programs took part in its work. The conference summarized results, designated a specific operating plan and made note of the most interesting and promising developments.

In particular, an original procedure whose name sounds somewhat strange--the "R-technology for program production"--has been developed at the Ukrainian SSR Academy of Sciences Institute of Cybernetics. This technology quickly "took root" in many organizations and institutions in the country. Where it has already been introduced the labor productivity of programmers has been increased approximately tenfold. And this is far from the limit.

The essence of the technology consists in "teaching" the computer to operate according to a program written in the form of a two-dimensional figure or drawing. This simplifies all stages in construction of a program and makes it possible to concentrate their preparation in special-purpose production lines. A complicated program is broken down into a number of simple ones and the computer itself participates in formulating each of them. Here individual operations are easily distributed among a much greater number of people than previously. Thus, the possibility is evidenced of forming a kind of assembly line for the production of programs. The new method of preparing them has already been used successfully in translating from one programming language to another, in constructing large information and reference systems and packages of applied programs, in automating editing and publishing operations, etc.

Furthermore, errors are reduced to a minimum as the result of the improvement of working conditions. For the purpose of "catching" errors a debugging bench has been created, supplied with the required computer peripherals, the memory of the computer containing a great number of test examples. The program is tested by solving them and errors are clearly evidenced.

Universal instrument facilities, called programmer technological complexes (RTK's), have been developed for working with the R-technology on BESM-6 and YeS series computers.

The experience of the mass employment of RTK's in organizations has demonstrated their high effectiveness. They facilitate and speed two- to threefold as a minimum the obtainment of a finished program product. The maximum productivity achievable by means of RTK complexes on a BESM-6 computer equals 2000 instructions per man per month. For mastery of the complexes 1.5 to 2 months are needed on average.

Users who were the first to master the R-technology and RTK complexes noted the following advantages which they have: the teamwork nature of the work of programmers according to a clear system from top to bottom, the ability to involve nonprofessional programmers, the resistance of the technology to design errors, the ease of adding corrections to solutions first received, effective control of the progress of performing jobs, the easy addition of new performers of the job, the effective distribution of jobs within a team, a small amount of documentation which is within one's power to master (as compared with the documentation for YeS computers).

The new technology has opened up real possibilities for the development of scientific studies aimed at the improvement and effective employment of computer technology in the national economy.

Furthermore, the training of programmers has also begun to be accomplished by means of computer technology and trainers developed on its basis. For example, a trainer has been developed on the basis of the "Iskra-126" program-controlled keyboard computer for the purpose of training in programming skills using ALGOL as a language.

Able to be listed among the advantages of this trainer are implementation of ALGOL in the dialogue mode, relatively low cost, small overall size and low power requirement, which makes it possible to install the trainer in practically any space. ALGOL is the most popular programming language among specialists making scientific and engineering calculations. A variant of ALGOL-60 expanded with letters of the Russian alphabet has been implemented in the trainer.

The functions of the trainer consist in composing and editing ALGOL programs from a problem-oriented keyboard with a complete check of the correctness of programs and detailed identification (determination, interpretation) of errors. Editing, debugging and the execution of programs on the computer require knowledge of a total of only 10 very simple keyboard manipulations. The functional completeness of the trainer makes possible the lack of dependence of training on the presence of a large-capacity computer.

The trainer processes directly any pressure on the keys; therefore, errors in execution are localized with a degree of accuracy of the operations in which they are

detected and they are identified by means of a conventional example. Taking the context into account makes it possible to reveal severalfold more errors than by means of compilers of general-purpose computers, and the dialogue mode to realize the requirement of the urgent correction of a detected error, which eliminates the undesirable superposition of errors in training.

Calculations of savings were made individually for capital and minor expenditures. It was established that the creation of VTsKP's [collective-use computing centers] will make it possible to reduce by 20 to 30 percent capital investment in computing equipment and communications facilities required for the automation of computing operations in our country, and to reduce operating costs two- to fourfold.

The savings from the creation of ASU's based on VTsKP's is seen most clearly in the reduction of the cost of processing a unit of information.

The concentration of computing equipment in large multicomputer complexes makes it possible to lower the cost of data processing approximately three- to fourfold as compared with the cost of processing data with the same models of computers used individually. In the future it is necessary to improve considerably the characteristics of YeS computers for the purpose of using them in VTsKP's. Calculations have demonstrated that the unit cost of data processing on a machine with a speed of two million to three million operations per second is approximately 30-fold lower than on a computer with a speed of 20,000 to 30,000 operations per second. Thus, it is possible to assume that the cost of data processing at a computing center furnished with two model YeS-1060 computers with a total execution rate of 2.5 million to 3 million operations per second is at least an order lower than at a computing center furnished with two model YeS-1020 computers.

Finally, it is easier also to solve the personnel problem, which is of great importance in the situation of the rapid replacement of computer generations: Electronic engineers, system engineers and programmers must be trained constantly and their knowledge must be improved. Under conditions of VTsKP's the need for highly skilled specialists is reduced 1.2- to twofold. The "collectivization" of computers will also make it possible to achieve a unique status for personnel servicing computing equipment, in the sense of wages and the like.

The theoretical advantages of collective-use computing centers will become real if a great amount of preparatory work is carried out. In particular, the organization at each enterprise of user stations and the creation of a unified system of communications channels, data classification and coding systems and a norm base. It is necessary to make an accurate determination of the range of enterprises which will utilize the services of a VTsKP.

It is assumed that a phase-one VTsKP will be able to render more than 30 kinds of services to users. It has been determined that in order for capital expenditures for the creation of such a VTsKP to be recovered in 3.5 years it must annually render services worth more than 3 million rubles.

The cost, thus, will be considerable, but the savings will be great. Each center of this sort will make it possible to save not less than 10 million rubles annually.

The All-Union Scientific Research Institute of Problems of Organization and Control with the participation of 60 scientific and planning organizations of ministries and departments has developed a feasibility study and an engineering project for a computing center network and the USSR State Committee for Science and Technology has approved them. The project includes a program for the creation in the country of a GSVTs [State Network of Computing Centers] and of the major territorial collective-use computing centers comprising it. Territorial VTsKP's were organized and approved by an interdepartmental commission in 1979 in Riga, Tallinn, Tula and Tomsk as a first step.

In the 11th Five-Year Plan period a large VTsKP will be created in Tashkent on the basis of the Uzbek SSR Gosplan GVTs [Main Computing Center]. Work is under way on the selection of 40 to 50 computing centers on whose basis work on the creation of VTsKP's will be expanded in the current five-year plan period.

The State Committee for Science and Technology has developed a standard project for a territorial VTsKP, which has facilitated their creation. Considerable work has also been done on unification of the information base: A unified system of classification and coding of technical and economic information has been developed, which at the present time consists of 26 all-Union and 81 sector (local) classifiers.

8831
CSO: 1863/23

OPTIMIZATION OF SECTOR PLAN FOR ESTABLISHING AUTOMATED CONTROL SYSTEMS

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian No 4, Jul-Aug 81 (manuscript received 15 Jun 79) pp 699-711

[Article by K. P. Glushchenko, Alma-Ata, in the section "Sector Planning and Management"]

[Text] An approach to drafting an optimal plan for establishing automated control systems (ASU) was suggested in [1]. Results were defined concretely in [2] where a version was presented for a model to optimize plans for ASU development in sectors of physical production intended for practical calculations.

This article generalizes the experience of using the approach, developed in [1, 2], in planning practice: to prepare proposals on the draft of the plan to automate control in the construction sector of republic subordination for the period 1981-1985. The main premises and grounds are presented concisely and attention is focused on applications, in particular, on analysis of specific conditions for application of theoretical results.

Statement of the Problem and Mathematical Model

The major problem being solved in drafting a sector plan for setting up ASU's is selecting the objects of automation (enterprises and other control elements) and establishing the scope of automation of control in them (i.e. the amount of outlays for the ASU's in each of these objects) and the schedule for establishing the ASU's included in the plan. To define the scope, one must know the economic effect from the ASU as a function of outlays made. It is hardly possible to derive it in the form of a continuous dependency for a concrete object in practice. This difficulty may be circumvented by forming a discrete set of ASU alternatives for each object (or group of like objects). An alternative is described by the indicators of economic effectiveness and expenditures for developing it. In optimizing a sector plan, one has to choose one (or rather, no more than one) alternative from the set of them for a given object.

The annual economic effect from an ASU is determined by the volume and cost of production prior to its introduction [3] and varies for the same alternative ASU both in time and (if it can be used in several objects) as a function of the object of introduction. Therefore, the indicators of economic effectiveness of an alternative are specified parametrically: by the factor of growth in the volume of realized production γ' and the factor of reduction in outlays per ruble of

realized production δ^v (v is the index of the ASU alternative). Then the annual profit increment (annual savings) through the functioning of the alternative of the ASU at the object s in the year t can be expressed in accordance with [3]*

$$Э_{st}^{v} = [\gamma^{v} A_{st}(1-\delta^{v} c_{st}) - P^{v}] - [A_{st}(1-c_{st})], \qquad (1)$$

where A_{st} and c_{st} are, respectively, the annual volume and outlays per ruble of realized production at enterprise s in year t with no ASU; and P^v is the annual cost for operation of alternative v.

Operating costs are also estimated by individual types of limiting resources r_q^v, where q is the index of the resource, $q \in Q^{(э)}$; $Q^{(э)}$ is the set of types of limiting resources for ASU operation. Expenses to establish alternative v are specified by years and determined both in cost terms K_τ^v, and by individual types of resources $r_{q\tau}^v$, where $q \in Q^{(p)}$, $Q^{(p)}$ are the set of limiting resources; τ is the year of establishment of the system from the start of it, $\tau = 1, \dots, \theta^v$; θ^v is the period for development of alternative v. Included in the one-time outlays K_τ^v, according to [4], are not only the direct capital investment for acquisition and assembly of the ASU hardware complex, but also expenses for system design and commissioning (organization of the information base, testing, personnel training and retraining and other measures to ready the object for the introduction).

Each ASU alternative analyzed is described by the set of parameters

$$\Pi^{v} = \{\gamma^{v}, \delta^{v}; \theta^{v}, (K_\tau^{v})_{\tau=1,\dots,\theta^{v}}, (r_{q\tau}^{v})_{\tau=1,\dots,\theta^{v},\, q\in Q^{(p)}}, P^{v}, (r_q^{v})_{q\in Q^{(э)}}\}.$$

Optimization of the sequence for establishing an ASU requires making use, for evaluating plan effectiveness, of an indicator that considers the dynamics of effecting outlays and obtaining the economic effect. Such an indicator is the integral economic effect for the calculated period of time T^*. It is the difference between the total results (annual increments of profit) in period T^* for all systems included in the plan and the outlays reduced to a moment of time. To account for the effect of the systems, development of which begins in plan period T and operation of them starts beyond it, the value of T^* must exceed T. Taken as the calculated period was a ten-year period (1981-1990) with five-year plan periods.

The system of limitations of the model includes a number of conditions typical for integral problems and resource limitations. Considered as limiting resources were: for ASU development--financial outlays of the sector for these purposes and the labor resources of the developers; for operation of the systems--computer capacity.

The model used for the calculations is a more detailed model from [1, 2] applicable to the conditions of the given sector.

---

* Let us consider here and from now on only enterprises as the objects of automation.

The quantities sought in the model are: $x_s^v = 1$, if alternative v is included in the plan at object s, and $x_s^v = 0$ in the opposite case, and $t_s^{(H)}$ is the year system development starts at object s. In the process, the model is notated like this

$$\text{Э} = \sum_{t=1}^{T^*} \sum_{s=1}^{S} \sum_{v \in V_s} \frac{\tilde{\text{Э}}_{st}^v(t_s^{(H)}) - K_{st}^v(t_s^{(H)})}{(1+E_{HH})^{t-1}} x_s^v - \sum_{s=1}^{S} \sum_{v \in V_s} E_s^v(t_s^{(H)}) x_s^v \to \max, \quad (2)$$

$$\sum_{s=1}^{S} \sum_{v \in V_s} \tilde{r}_{qst}^v(t_s^{(H)}) x_s^v \leq R_{qt}, \quad q \in Q^{(p)} \cup Q^{(э)}, \; t = 1, \ldots, T, \quad (3)$$

$$\sum_{v \in V_s} x_s^v \leq 1, \quad x_s^v \in \{0, 1\}, \quad s = 1, \ldots, S, \quad v \in V_s, \quad (4)$$

$$t_s^{(H)} \in \{1, \ldots, T\}, \quad s = 1, \ldots, S. \quad (5)$$

Here

$$\tilde{\text{Э}}_{st}^v(t_s^{(H)}) = \begin{cases} \text{Э}_{st}^v, & t \geq t_s^{(H)} + \theta^v, \\ 0, & t < t_s^{(H)} + \theta, \end{cases} \quad (6)$$

$$K_{st}^v(t_s^{(H)}) = \begin{cases} K^v_{s,\, t-t_s^{(H)}+1}, & t \in [t_s^{(H)}, t_s^{(H)} + \theta^v - 1], \\ 0, & t \in [t_s^{(H)}, t_s^{(H)} + \theta^v - 1], \end{cases} \quad (7)$$

$$\tilde{r}_{qst}^v(t_s^{(H)}) = \begin{cases} r^v_{qs,\, t-t_s^{(H)}+1}, & q \in Q^{(p)} \,\&\, t \in [t_s^{(H)}, t_s^{(H)} + \theta^v - 1], \\ r_q^v, & q \in Q^{(э)} \,\&\, t > t_s^{(H)} + \theta^v, \\ 0 & \text{in all other cases.} \end{cases} \quad (8)$$

Symbols used in addition to those introduced earlier: S is the total number of potential objects for automation; V_s is the set of ASU alternatives defined for enterprise s; E_{HH} is the norm of reduction (E_{HH} = 0.1 [4]); and R_{qt} is the limit of resource of type q for the year t. The values of Э_{st}^v are calculated by formula (1).

All enterprises are divided into two groups and a single set of ASU alternatives is formed for each group. A heuristic algorithm based on this feature was used to solve problems (2)-(5). Since within a group, outlays for a given ASU alternative do not depend on a specific object, permissible calendar plans (schedules) for development of systems may be formed without attachment to the objects, provided the total number of alternatives included in the plan for the enterprises of a

a group S_i would not exceed the number of enterprises themselves N_i, where i is the group index. The schedule is a matrix (n_{vt}), where n_{vt} is the number of ASU's, development of which begins on alternative v in year t; v = 1, ..., V, where V is the total number of ASU alternatives in all groups of objects, t = 1, ..., T. Then the permissible schedule must satisfy (3) and

$$\sum_{v \in V_i} \sum_{t=1}^{T} n_{vt} \leq N_i, \quad V_i = \bigcup_{s \in S_i} V_s, \tag{9}$$

as well as the condition of completeness of utilization of resources: introduction into the schedule of even one additional ASU alternative would not be possible without violating (3) and (or) (9). When the schedule is constructed, it must be attached to specific objects in a way such that the maximal effect is achieved. This is done the following way. There are

$$(s_0, v_0, t_0) = \arg \max_{(s, v, t \mid n_{vt} \neq 0, \, v \in V_s)} E_s^v(t) \tag{10}$$

($E_s^v(t)$ is determined by (2)). Object s_0 with alternative v_0 and the start of its development in year t_0 is fixed in the plan and deleted from the matrix $E_s^v(t)$, the value of $n_{v_0 t_0}$ is reduced by one, after which operation (10) is performed again. This process is repeated until all elements of the matrix (n_{vt}) become zero.

An exhaustive search of permissible schedules may be performed and not only the optimum found, but also the set of suboptimal solutions, using the cited algorithm in an acceptable time when S = 40, T =5 and V = 4.

Intital Data for Calculations

Basic Prerequisites. A number of factors peculiar to the construction industry, in particular the territorial separateness of the objects of construction, at present prevents adequate efficient automation of problems with a high frequency of solution (the type of problems of daily calendar planning and of expeditious control). An insignificant percentage of problems with daily periodicity within construction organization ASU's leads to the lack of a full load on the computers during system operation. A consequence of this is the orientation to shared utilization of computer hardware.

In the sector under investigation, the shared computer centers (VTsKP) are organizationally a part of the Planning and Design Office for Development and Introduction of ASU's (PKB ASU) that has a network of territorial branches. The major tasks of the PKB ASU for the construction industry are: ASU development on a standard basis, assimilation and tying to specific conditions of standard jobs and application program packages (PPP), and exploitation of ASU software. In the process, computer hardware is also used to carry out work on debugging and test operation of software for ASU's under development, debugging and solving individual problems not included in them, assimilation of standard software, etc. In the process, shared

computer centers are usually established before ASU's are introduced at objects, that territorially gravitate to the places they are located, and this is done to a sufficient extent irrespective of the specific prospects for ASU development at the potential users. Thus, the ASU's developed are oriented, as a rule, to the computer centers that are already functioning.

An extensive development of efforts to establish general construction trust ASU's on a unified basis is planned in the 11th Five-Year Plan. Their software standardization is based on using the "Stroytrest" [Construction Trust] application program package that is a generator of programs that allow solving optimization problems of calendar planning and data processing problems pertinent to the construction industry [5].

Calculations for optimizing the plan for establishing ASU's in the sector for 1981 to 1985 covered only general construction trusts, since mass automation of management is not planned in other objects for this period. There are sufficient grounds for assuming that development will be performed in the period in question through the growth of existing trusts, not through formation of new ones. Also in connection with this, calculations were made on the assumption that the composition of trusts making up the sector would not change for the given length of time.

The indicators used as initial data can be divided into three groups: potential objects for automation, ASU alternatives and resource limits.

Data on Objects. Considered as potential objects for automation were 40 general construction trusts--all those in which ASU's will not be functioning by 1981 or efforts to establish them that had begun in the preceding five-year plan will be in progress.

Annual volume of construction and installation work (SMR) performed by in-house efforts was used as the indicator A_{st}, and outlays per ruble of SMR of the indicated type (ratio of production cost of this work to their estimated cost) was used for c_{st}. The total dynamics of development of the trust was described by the annual volume of SMR (A_{st}').

An extrapolation forecast of the dynamics of the indicators A_{st}', A_{st} and c_{st} for the period 1981-1990 in a year-by-year breakdown was used as initial data for the calculations. These data for three points of the plan horizon are shown in table 1.

Indicators for ASU Alternatives. Potential objects for automation were divided into two groups and a single set of possible ASU alternatives was formed for each group. The first group included major trusts--with an annual SMR volume from 45 to 80 million rubles; the second group--medium-size trusts with an annual volume from 10.5 to 35 million rubles. Affiliation of an ASU alternative to a group will be designated by the numbers 1 or 2, respectively.

Each set of ASU alternatives contained two system alternatives: minimal (M) or expanded (R) which differ by the composition of jobs automated. Thus, the initial data were four ASU alternatives: minimal for trusts in group 1 (M1), expanded for trusts in group 1 (R1), minimal for trusts in group 2 (M2) and expanded for trusts in

Table 1. Forecast of dynamics of development of potential objects for automation

(1) Шифр треста	A'_{gi}, млн. руб. (2)			A_{gi}, млн. руб. (2)			c_{gi}, руб. (3)		
	1981	1985	1990	1981	1985	1990	1981	1985	1990
11	57,0	63,0	68,5	37,6	41,6	45,2	0,97	0,94	0,91
12	52,0	57,5	62,0	30,2	34,5	38,8	0,97	0,94	0,91
13	60,0	62,5	65,5	45,8	47,5	49,8	0,96	0,94	0,91
14	27,0	29,2	31,5	20,5	22,2	23,9	0,98	0,94	0,91
21	26,0	27,0	28,4	16,1	16,7	17,6	0,96	0,94	0,92
22	26,0	28,5	32,1	19,2	21,1	23,8	0,98	0,96	0,92
23	24,0	25,0	26,2	18,5	19,2	20,2	0,98	0,96	0,92
24	24,0	26,0	28,7	16,0	17,4	19,2	0,97	0,95	0,92
31	31,0	32,2	33,9	24,2	25,1	26,4	0,98	0,96	0,92
32	29,7	36,4	45,2	19,0	24,8	30,7	0,96	0,93	0,90
33	30,9	33,9	37,5	22,9	25,1	27,8	0,91	0,89	0,87
34	10,6	14,0	18,4	9,1	12,0	14,7	0,99	0,98	0,95
35	20,3	21,5	22,6	15,4	16,3	17,2	0,93	0,92	0,88
36	27,3	33,2	40,3	20,5	24,9	30,2	0,94	0,92	0,89
37	26,8	30,1	33,6	20,6	23,2	25,9	0,92	0,90	0,86
41	15,5	17,4	19,8	12,6	14,1	16,0	0,96	0,94	0,91
42	14,0	16,7	19,0	10,2	12,2	13,9	0,97	0,95	0,91
43	17,5	19,7	22,5	13,3	15,0	17,1	0,96	0,95	0,90
51	50,0	58,5	69,5	27,5	36,9	48,5	0,96	0,94	0,91
52	35,0	40,1	46,6	30,4	34,9	40,5	0,96	0,94	0,91
53	18,0	19,1	20,6	10,4	11,7	13,2	0,98	0,96	0,94
61	75,0	80,0	84,0	36,0	41,6	47,0	0,95	0,93	0,90
62	35,0	38,0	41,8	27,6	30,0	33,0	0,92	0,92	0,88
63	30,0	33,8	38,5	19,8	22,3	25,4	0,94	0,93	0,90
64	27,0	32,0	37,5	20,3	24,0	28,1	0,97	0,95	0,91
71	35,0	36,4	38,3	23,4	24,4	25,7	0,94	0,92	0,88
72	18,5	19,6	21,2	16,6	17,6	19,1	0,95	0,93	0,90
73	34,0	36,8	40,5	17,0	19,9	23,5	0,96	0,93	0,90
74	14,0	14,9	15,6	11,5	12,2	12,8	0,97	0,95	0,92
75	16,0	17,3	19,0	11,0	11,9	13,1	0,97	0,95	0,93
81	45,0	54,7	69,5	27,9	33,9	43,1	0,86	0,85	0,84
82	32,0	36,7	42,5	27,8	31,9	37,0	0,90	0,89	0,86
83	17,0	19,0	20,0	10,4	11,6	12,2	0,94	0,92	0,88
84	18,5	20,0	22,0	14,1	15,2	16,7	0,94	0,92	0,88
91	30,0	34,5	40,0	21,6	24,8	28,8	0,87	0,87	0,85
92	27,0	30,4	34,7	23,4	26,3	30,0	0,93	0,91	0,87
93	31,0	36,3	42,0	15,5	19,6	24,4	0,90	0,88	0,85
94	18,0	21,9	26,5	14,0	17,1	20,7	0,94	0,92	0,88
01	45,0	50,0	56,5	36,5	39,5	44,6	0,98	0,95	0,91
02	51,0	53,0	55,8	37,7	39,7	41,3	0,97	0,94	0,91

Key:
1. Trust number
2. Millions of rubles [in the Russian notation, the comma indicates the decimal point]
3. Rubles

group 2 (R2). The minimal alternative includes 17 problems in the subsystems for management of engineering preparation for production, technical-economic planning, expeditious management of production and management of supply of materials and equipment. The expanded alternative covers, in addition to the minimal, a number of problems within the bounds of the subsystems listed, as well as the subsystems for

quality control and personnel management*, 47 problems in all. The composition of problems in the minimal and expanded alternatives for trusts of both groups 1 and 2 is the same. In the process, it is assumed that the ASU economic effectiveness indicators γ' and δ' and the system design costs are determined by the composition of problems being automated alone. Operating costs and expenses for introduction of the ASU's with a given set of problems are a function of the affiliation of a trust to a group.

The factors of growth in volumes and reduction in outlays per ruble of construction and installation work performed by in-house efforts through functioning of ASU's (gamma^{V} and delta^{V}) were found by averaging the results obtained in calculating (by the technique in [3]) the economic effect of the corresponding ASU alternatives for a number of trusts. The increase in volumes of SMR performed by in-house efforts through automation of management is: 3.7 percent (gamma = 1.037) for ASU minimal alternatives, and 5.9 percent (gamma = 1.059) for the expanded; the reduction in unit outlays is 0.9 percent (delta = 0.991) and 2.0 percent (delta = 0.980) respectively.

Outlays for development and introduction of the formed ASU alternatives and operating expenses were determined on the basis of experience in developing these systems in construction trusts, results of experimental use of the "Stroytrest" PPP, and expert estimates. Isolated in the process were costs for system design (survey and technical-economic substantiation, development of specifications, engineering working design, including generation of programs using the PPP and debugging them) and for putting it into operation (creation of the information base, recording it on machine media, test operation of the ASU and other measures on system implementation). Since access to a shared computer center is assumed without installation of peripherals in the trusts, there are no costs for acquisition and installation of a complex of hardware and operations associated with it. The total costs for development of the formed ASU alternatives and their composition are shown in table 2.

Design costs consist of: wages for developers; machine time for generation, tie-in and debugging of programs; and other expenses. We estimated development labor input for the minimal ASU alternatives as 20 man-years, and 30 man-years for the expanded; machine time outlays as 300 and 400 hours respectively (here and subsequently, machine time is estimated for the YeS-1022 type computer, and the cost of one machine-hour is 85 rubles). Development period for all alternatives is two years.

Costs for putting the system into operation include: wages for personnel who create the information base; and costs for computer center services for recording it on machine media and test operation of the ASU (payment for machine time). While for system design, costs are determined largely by the set of problems being automated alone, for implementation, the determining factor in costs is, as a function of the size of the enterprise, the volume of information processed in the automated mode. Thus these costs are determined by trust affiliation to group 1 or 2. For the trusts in a group, the volume of this information and the corresponding cost items

---

* This subsystem is based on using the "Kadry" [Personnel] PPP [applications program package] [6].

Table 2. Costs for establishing the formed ASU alternatives, in thousands of rubles

(1) Вариант АСУ	(2) Затраты на проектирование, А				(3) Затраты на ввод системы в эксплуатацию, Б			Всего (7)
	заработная плата (4)	машинное время (5)	прочие расходы (6)	итого (7)	заработная плата (4)	машинное время (5)	итого (7)	
M2	36,0	25,6	37,8	99,4	16,4	12,8	29,2	128,6
M1					27,9	21,3	49,2	148,6
R2	54,0	34,0	53,5	141,5	24,6	17,0	41,6	183,1
R1					41,1	34,0	75,1	216,6

Key:
1. ASU alternative
2. Design costs, A
3. Commissioning costs, B
4. Wages
5. Machine time
6. Other expenses
7. Total

Table 3. Annual costs for operation of the formed ASU alternatives

(1) Вариант АСУ	(2) Статьи затрат				Всего в год, тыс. руб. (8)
	(3) содержание группы эксплуатации АСУ		(6) машинное время		
	(4) чел.	(5) тыс. руб.	(7) час	(5) тыс. руб.	
M2	10	16,4	600	51,0	67,4
M1	17	27,9	1000	85,0	112,9
R2	15	24,6	900	76,5	101,1
R1	20	41,1	1500	127,5	168,6

Key:
1. ASU alternative
2. Cost items
3. Salaries for ASU operating group
4. Personnel
5. Thousands of rubles
6. Machine time
7. Hours
8. Total per year, thousands of rubles

are considered sufficiently close (indeed, the groups were formed based on these considerations).

Costs are spread over the years for system establishment based on the time distribution of work on its design and implementation the following way: 38 percent for the first year and 62 percent for the second (for all ASU alternatives).

Annual costs P^V for ASU operation are shown in table 3. They include: wages for personnel supporting system operation directly in the trust (trust ASU operating group), and payment for shared computer center services. Since we assume no peripherals directly in the trust, there are no cost items for this.

Table 4. ASU alternative indicators used in the calculations

(1) Вариант АСУ	γ^v	δ^v	(2) θ^v, лет	$r^v_{q\tau}$,				P^v, тыс. руб. (3)	$r^v_{q=3}$, тыс. час (5)
				$\tau=1$		$\tau=2$			
				$q=1$, тыс. руб. (3)	$q=2$, чел. (4)	$q=1$, тыс. руб. (3)	$q=2$, чел. (4)		
M2	1,037	0,991	2	48,9	10	79,7	10	67,4	0,6
M1	1,037	0,991	2	56,5	10	92,1	10	112,9	1,0
R 2	1,059	0,980	2	69,6	15	113,5	15	101,1	0,9
R 1	1,059	0,980	2	82,3	15	134,3	15	168,6	1,5

Key:

1. ASU alternative
2. Years
3. Thousands of rubles
4. Personnel
5. Thousands of hours

Initial data for the ASU alternatives assumed for the calculations are shown in consolidated table 4 using the notation of model (1)-(8). Resource indexes have the following meaning: q = 1 corresponds to the financial resources for ASU establishment (i.e. $r_{1\tau}^v = K_\tau^v$), q = 2 is the ASU developers and q = 3 is the computer capacity for ASU operation, measured in machine time outlays (thus, $Q^{(p)} = \{1, 2\}$, $Q^{(e)} = \{3\}$).

Resource Limitations. As mentioned before, we considered the following as limitations: financial resources for automation of management in a sector; number of developers knowing the methods of ASU design based on the "Stroytrest" PPP (and the "Kadry" PPP); and machine time for system operation. Limits on resources assumed in the calculations as initial data are shown in table 5.

Table 5. Resource Limitations

Index of resource q	Resource Type	Values of limits by years, R_{qt}: 1981	1982	1983	1984	1985
1	Financial outlays, millions of rubles	1.75	1.85	2.0	2.0	2.1
2	Number of trained developers, personnel	30	50	80	100	120
3	Machine time for ASU operation, thousands of hours	8.0	12.0	16.0	20.0	24.0

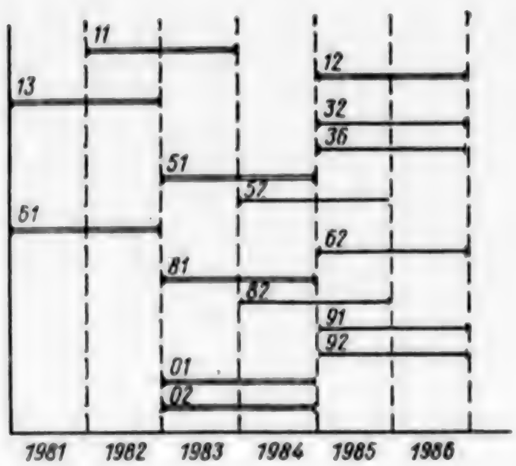
The limit of financial outlays for establishing ASU's was determined in accordance with the recommended norm [7, page 106] at a scale of 3 percent of the total amount of outlays for development of the sector, i.e. from the forecasted production capital investment for the sector as a whole. These limits were reduced by the amount

of outlays for acquisition of hardware for the shared computer center (from estimating delivery of one YeS-1022 type computer annually during the entire given plan period). Total machine time resources were reduced with regard to expenses for them needed by the PKB ASU to perform advance scientific and technical work; in other words, the total resources do not include time for debugging problems and other work on ASU's under new development since it may be done on leased computers in other sectors.

The forecast for dynamics of growth in number of developers capable of adequately performing system design based on the "Stroytrest" PPP was made on the basis of expert estimates by PKB ASU managers.

Results of Calculations and Analysis of Them

Indicators for the optimal plan are shown in tables 6 and 7.* The linear graph of establishing ASU's in the sector that corresponds to this plan is shown in the figure. The optimal plan provides for introduction of ASU's in 15 trusts, including 9 systems to be put into operation in the 11th Five-Year Plan, and 6 crossing over into the 12th. The objects planned for automation are 37.5 percent of the total. All of group 1 was included in the plan (i.e. all major trusts with an SMR volume of 45 or more million rubles). ASU's with the expanded composition of problems being automated (the R1 and R2 alternatives) were planned for all objects. The integral economic effect for the period 1981-1990, reduced to 1981 (the value of the efficiency function Э), for this plan is 32.71 million rubles.



Dynamics of establishing ASU's by the optimal plan: double line denotes ASU alternative R1; single line--ASU R2

---

* In calculating the integral economic effect and total investment of resources in ASU development in the sector, outlays were not considered for acquisition and installation of computer hardware since, as noted before, in this case, this process is planned irrespective of the specific program of effort on ASU and, consequently, they are identical for all its alternatives.

Table 6. Optimal-by-object plan for establishing ASU's*

(1) Шифр треста, s	(2) Вариант АСУ, v	(3) Год начала создания, $t_s^{(н)}$	(4) Год начала эксплуатации, $t_s^{(э)}$	Годовой прирост прибыли на год начала эксплуатации $Э_{st}^{v(н)}$, (5) тыс. руб.
11	P1	1982	1984	770,4
12	P1	1985	1987	698,7
13	P1	1981	1983	904,2
32	P2	1985	1987	552,4
36	P2	1985	1987	560,2
51	P1	1983	1985	696,7
53	P2	1984	1986	758,7
61	P1	1981	1983	754,9
62	P2	1985	1987	663,5
81	P1	1983	1985	741,7
82	P2	1984	1986	745,0
91	P2	1985	1987	597,8
92	P2	1985	1987	595,3
01	P1	1983	1985	742,7
02	P1	1983	1985	738,8

* Year operation begins $t_s^{(э)} = t_s^{(н)} + \theta^v$.

Key:
1. Trust number
2. ASU alternative [Russian "P" = English "R"]
3. Year development begins
4. Year operation begins
5. Annual increment in profit for year operation begins, thousands of rubles

Table 7. Overall indicators of optimal plan

Indicators	Value of indicators by years of plan period					
	1981	1982	1983	1984	1985	total for 1981—1985
Прирост прибыли, (1) млн. руб.	—	—	1,650	2,486	5,492	9,628
Прирост объемов СМР, (2) млн. руб.	—	—	5,044	7,611	16,532	29,187
Затраты, млн. руб. (3)	0,165	0,351	0,464	0,676	0,657	2,313
Количество разработчиков, чел. (4)	30	45	75	90	120	—
Машинное время ЕС-1022 на эксплуатацию АСУ, тыс. час (5)	—	—	3,0	4,5	10,5	—

Key:
1. Increment in profit, millions of R
2. Increment in SMR volumes, millions of rubles
3. Outlays, millions of rubles
4. Number of developers, personnel
5. YeS-1022 machine time for ASU operation, thousands of hours

By comparing resource consumption for plan realization (table 7) with the resource limitations (table 5), it can be seen that the limits on financial outlays for ASU development and for computer capacity are not restrictive. The only limiting restriction is the number of developers; however, the forecasted dynamics of its growth does not fully correspond to the dynamics of the requirement for the optimal plan, which results in underutilization of this resource in the years 1982-1984.

Financial outlays for efforts on automating management in the optimal plan turned out to be substantially below the norms. This is due to the far smaller requirement for computer capacity to operate construction organization ASU's compared to that for ASUP [automated production control systems] and to the orientation to shared use of computer hardware, while the norm (3 percent of the total outlays for sector development) is based on the experience of ASU development in industry where, as a rule, computers are acquired for each system introduced. Standardization of ASU design also reduces outlays considerably. The unused remainder of financial resources allows providing for development and implementation of nonstandard systems (which require individual design) which have not been considered in the calculations.

Incomplete use of computer capacity is associated with the advance commissioning of it. The high rate of growth in the need for it should be noted: about 20 percent of the machine time resource will be needed for ASU operation in 1983, about 25 percent in 1984 and about 50 percent in 1985. The reserve in the machine time resource in the plan period will allow debugging and test operation of software for the ASU's under development in sector computer centers without resorting to leasing it from other organizations. The size of this reserve allows considering that requirements for computer capacity to operate nonstandard systems not considered in the calculations will also be satisfied.

According to [3], the effectiveness of capital investment for ASU development, computed for the first year of its operations, must be no less than the norm set for computer hardware. For all systems included in the plan, the estimated factors of effectiveness of the outlays for their development exceed the norm value set for both the national economy as a whole ($E_{nch} = 0.3$) and the "Construction" sector ($E_{nch} = 0.32$ [8]). [nch = norm computer hardware]

The set of suboptimal plans $\{\omega\}$ consists of plans meeting the condition $Э^{\omega} > Э^{0}(1-\varepsilon)$, where $Э^{\omega}$ is the value of the efficiency function $Э$ (integral economic effect) for plan ω; $Э^{0}$ is the value of $Э$ in the optimal plan; and $0<\varepsilon<1$.

Suboptimal solutions for $\varepsilon = 0.03$ (3 percent) compared to optimal are given in table 8; in them, elements differing from corresponding elements in the optimal plan are underlined by a fine line. It can be seen from the table that the set of objects for automation falling in the solution with a hgh value of the efficiency function is rather stable: 12 of 17 trusts are included in all suboptimal plans. The ASU development periods in the various solutions vary insignificantly, and the ASU alternatives planned for realization in the individual objects also largely coincide. From this it can be concluded that in the set of permissible plans there are none that would yield an efficiency function value closer to maximal and differ substantially from the optimal at the same time. This allows concluding that the optimal solution is rather stable.

Table 8. Set of suboptimal plans

Trust number	optimal plan	suboptimal plans 1	2	3	4	5	6	7	8	9	10
		Year ASU development begins in trust/ASU alternative being developed (1)									
44	2/P1	2/P1	2/P1	2/P1	2/P1	2/P1	2/P1	2/M1	2/P1	2/P1	2/P1
12	5/P1	4/P1	5/P1	5/P1	4/P1	4/P1	5/P1	3/P1	3/P1	3/M1	–
13	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1	4/P1	1/P1
32	5/P2	5/P2	5/P2	5/P2	–	–	–	5/P2	5/P2	5/P2	5/P2
33	–	–	–	–	4/M2	3/M2	4/M2	3/M2	3/M2	5/P2	5/P2
36	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2
87	–	–	–	–	–	3/M2	–	–	–	–	5/P2
54	3/P1	3/P1	4/P1	4/P1	3/P1	3/P1	4/P1	4/P1	4/P1	4/P1	3/P1
58	4/P2	4/P2	3/P2	3/P2	4/P2	5/P2	3/P2	3/P2	3/P2	3/P2	3/P2
61	1/P1	1/P1	1/P1	4/P1	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1	1/P1
62	5/P2	5/P2	3/P2	3/P2	5/P2	5/P2	3/P2	5/P2	3/P2	5/P2	4/P2
81	3/P1	3/P1	3/P1	4/P1	3/P1	3/P1	3/P1	3/P1	4/P1	3/P1	3/P1
82	4/P2	5/P2	3/P2	3/P2	5/P2	5/P2	3/P2	3/P2	3/P2	3/P2	4/P2
91	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2
92	5/P2	5/P2	5/P2	3/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2	5/P2
01	3/P1	3/P1	4/P1	5/P1	3/P1	3/P1	4/P1	4/P1	5/P1	4/P1	3/P1
02	3/P1	3/P1	5/P1	5/P1	3/P1	4/P1	5/P1	5/P1	5/P1	3/M1	–
(2) Значение целевой функции	32,71	32,65	32,50	32,30	32,19	32,16	32,10	32,07	31,94	31,90	31,89
(3) Количества систем	15	15	15	15	15	16	15	16	16	16	15

Key:
1. [Russian "P" = English "R"]
2. Value of efficiency function [comma = decimal point]
3. Number of systems

Table 9. Plan alternatives

Trust number Шифр треста	Год начала создания АСУ/вариант АСУ(1)		
	оптимальный план (2)	(3) план А	(4) план В
11	2/P1	2/P1	2/P1
12	5/P1	5/M1	5/M1
13	4/P1	4/P1	4/P1
32	5/P2	4/M2	—
33	—	3/M2	4/M2
36	5/P2	4/M2	4/M2
37	—	4/M2	—
51	3/P1	4/M1	5/P1
52	4/P2	5/P2	4/P2
61	1/P1	1/P1	1/P1
62	5/P2	3/M2	4/M2
64	—	5/M2	—
71	—	6/M2	—
81	3/P1	4/M1	4/M1
82	4/P2	3/M2	3/M2
91	5/P2	3/M2	4/M2
92	5/P2	3/M2	4/M2
01	3/P1	5/M1	4/M1
02	6/P1	5/M1	4/M1
Интегральный экономический эффект, млн. руб. (5)	32,71	23,75	22,61
Прирост прибыли за 1981–1985 гг., млн. руб. (6)	9,63	8,08	7,04
Прирост объемов СМР за 1981–1985 гг., млн. руб. (7)	29,19	25,48	21,55
Количество систем, шт. (8)	15	19	15

Key:

1. Year ASU development begins/ASU alternative [Russian "P" = English "R"]
2. Optimal plan
3. Plan A
4. Plan B
5. Integral economic effect, millions of rubles [comma = decimal point]
6. Increment in profit for period 1981 to 1985, millions of rubles
7. Increment in SMR volumes for period 1981-1985, millions of rubles
8. Number of systems

Unfortunately, it is not possible to compare the results of the calculations with the plan derived by the traditional method since at the time the calculations were made, there was no such plan for the 11th Five-Year Plan, while the plan for the 10th Five-Year Plan was incompatible both in scope and content of planned work. Optimization effectiveness can be estimated indirectly by comparing the optimal solution with plans where a limiting resource (ASU developers) is fully utilized and which are a priori rather effective. Two such plans are compared with the optimal in table 9.

Plan A calls for ASU development in 19 trusts, including all those in the optimal plan, i.e. at first glance, it has some advantages over it. However, the integral economic effect of plan A is 27.2 percent lower than the optimal; the total

increment in profit for the five-year period derived from operating an ASU is 16.3 percent lower, and the additional volume of construction and installation work is 12.7 percent lower. It can be seen from a comparison with the optimal plan that the lower resulting indicators of plan A are due to the large coverage by automation of management of various objects achieved by developing less efficient ASU alternatives. Plan B includes the same number of objects for automation as the optimal and has no obvious shortcomings, but its effectiveness indicators are even lower than those for plan A. This indicates that efficient plans that could well have been adopted when traditional methods are used to draft them are inadequately close to the optimal. Hence, we conclude the optimization is effective.

The author is deeply grateful to V. A. Kalantayevskiy for much help in collecting, preparing and analyzing the initial data and discussing the results.

BIBLIOGRAPHY

1. Glushchenko, K. P., "Problems of Planning and Organization of ASU Developments," EKONOMIKA I MATEMATICHESKIYE METODY, Vol 12, No 3, 1976.

2. Glushchenko, K. P., "Planning ASU Developments within the Bounds of Sector Programs for Scientific and Technical Progress," in "Problemy povysheniya effektivnosti sistem upravleniya otraslyami, predpriyatiyami, ob"edineniyami v promyshlennosti (Materialy konferentsii)" [Problems of Raising Efficiency of Systems for Management of Sectors, Enterprises and Associations in Industry (Conference Materials)], Novosibirsk, IEiOPP SO AN SSSR [Institute of Economics and Organization of Industrial Production, Siberian Department, USSR Academy of Sciences], 1977.

3. "Metodika opredeleniya ekonomicheskoy effektivnosti avtomatizirovannykh sistem upravleniya prepriyatiyami i proizvodstvennymi ob"yedineniyami" [Technique for Determining the Economic Effectiveness of Automated Systems for Management of Enterprises and Production Associations], Moscow, Statistika, 1979.

4. "Metodika (osnovnyye polozheniya) opredeleniya ekonomicheskoy effektivnosti ispol'zovaniya v narodnom khozyaystve novoy tekhniki, izobreteniy i ratsionalizatorskikh predlozheniy" [Technique (Basic Principles) for Determining the Economic Effectiveness of the Utilization of New Technology, Inventions and Work Improvement Suggestions in the National Economy], Moscow, Ekonomika, 1977.

5. "Paket prikladnykh programm 'Planirovaniye i uchet stroitel'no-montazhnykh rabot stroitel'nogo tresta' (PPP 'Stroytrest') na baze OS YeS. Kratnoye opisaniye primeneniya" [Applications Program Package "Planning and Accounting of Construction and Installation Work for Construction Trust" (PPP "Stroytrest") on the Base of YeS OS: Brief Description of Use], Kalinin, Tsentrprogrammsistem, 1980.

6. "Paket prikladnykh programm 'Kadry-OS' na baze OS YeS. Kratnoye opisaniye primeneniya" [Applications Program Package "Personnel-OS" Based on Unified System Operating System: Brief Description of Use], Kalinin, Tsentrprogrammsistem, 1980.

7. Lapshin, Yu. P., "Razvitiye avtomatizirovannykh sistem upravleniya v promyshlennosti" [Development of Automated Management Systems in Industry], Moscow, Ekonomika, 1977.

8. "Metodicheskiye polozheniya po sostavleniyu pyatiletnego plana vnedreniya vychislitel'noy tekhniki v upravleniye narodnym khozyaystvom" [Methodological Principles for Compiling the Five-Year Plan for Introducing Computer Technology into the Management of the National Economy], Moscow, NIIPiN pri Gosplane SSSR [Scientific Research Institute of Planning and Standards, USSR State Planning Committee], 1975.

8545
CSO: 1863/254

GLUSHKOV ON STATEWIDE AUTOMATED DATA COLLECTION AND PROCESSING SYSTEM

Riga SOVETSKAYA LATVIYA in Russian 30 Aug 81 p 2

[Interview with V. M. Glushkov by Viktor Lupandin, date and place not specified]

[Excerpts] Fundamental work is being done in our country on the creation of the statewide automated data collection and processing system. Novosti correspondent Viktor Lupandin interviews vice-president of the Academy of Sciences of the Ukraine, director of the Institute of Cybernetics of the UkrSSR Academy of Sciences, academician V. M. Glushkov about problems connected with its creation and about its role in the development of the national economy.

Question: "What is the technical basis of the statewide automated data collection and processing system?"

Answer: "The basic element of any computer system is the electronic computer. The capacity of the computer pool of the country is one of the most important indicators of the scientific and technological development of society. At the present time we have at our disposal a fairly large number of universal and control computers. The technical level has been raised. As early as the start of the 70's third-generation computers of type "Ryad-1" began to be produced. Now a program of further improvement of production and the technical-economic level of computers and peripherals is designated. It envisages primarily the development and production of powerful computers, with an expansion of their functional possibilities. It is a matter of the production of series "Ryad-2" computers with a speed of 150,000 to 4-5 million operations per second. They have an expanded main and superfast memory, which permits servicing hundreds of users on collective principles. Besides type "Ryad-2" computers the USSR Ministry of the Radio Industry is developing computer systems with a speed of 12 million (type VS-1) to 125 million (type VS-2) operations per second. Those computer systems will be used in solving very complicated scientific and technical problems, and also in the creation of territorial centers for collective use with the servicing in the long term to 1990 of 600,000 enterprises and organizations. The "Ryad-2" computers will become the main technical base of computer centers of all levels in the next ten years.

Question: "How much time in all will be required for the creation of the statewide automated data collection and processing system?"

Answer: "The real period required for the creation of the system in its entire volume will depend on the solution of many complex problems. One of the most important ones is the training of personnel for the system. Faculties of cybernetics and applied mathematics have already been opened and are working fruitfully at Moscow, Leningrad, Kiev and Novosibirsk universities. But instructors are needed for those faculties and they must be trained too. So that, starting only from the solution of this problem it can be a matter of at least 1.5-2 decades."

2174
CSO: 1863/12

UDC 681.3"71"

THIRD GENERATION COMPUTERS

Moscow AVTOMATIKA, TELEMEKHANIKA I SVYAZ' in Russian No 7, Jul 81 pp 29-32

[Table from article by engineer S. I. Sergeyev]

[Excerpt] The editorial board continues to publish articles under the general title "computer generations." First- and second-generation computers were discussed in the two previous articles. The second part of the given article on third-generation computers is planned for publication in one of the future issues of the journal.

Model	Manufacturer	Speed, thousand operations per second	Storage Capacity, Kbytes	Remarks
YeS-1010	Hungarian Peoples Republic	10	256	Taken out of production
YeS-1011	Hungarian Peoples Republic	10	512	--
YeS-1020	USSR and Peoples Republic of Bulgaria	20	256	Taken out of production
YeS-1021	CSSR	20	512	--
YeS-1022	USSR and Peoples Republic of Bulgaria	80	512	--
YeS-1030	USSR	60	512	Taken out of production
YeS-1032	Polish Peoples Republic	200	512	--
YeS-1033	USSR and Polish Peoples Republic	200	512	
YeS-1040	GDR	400	1,024	Taken out of production
YeS-1050	USSR	500	1,024	The same
YeS-1052	USSR	700	2,048	--

6521
CSO: 1863/I

A6401 ROBOTRON

Moscow EKONOMICHESKAYA GAZETA in Russian No 37, Sep 81 p 23

[Text] The A6401 Robotron is a two-address computer that has a processable information scope of 16 bits and a memory capacity of 32K words. The main memory is composed of modules and has an optimum configuration. The A6401 Robotron is intended particularly for accounting for stock and basic equipment and calculating types and items of expenditures; it is used in production planning and trade, in inventorying and in hospitals, as well as for personnel record-keeping. From our problem-oriented systems documentation, which is constantly being improved, the operations that the Robotron A6401 performs can be ascertained. Systems documentation is also available for standard mathematical functions and mathematical methods, as well as the organization of data.

Manufacturer: Robotron Export-Import, Volkseigener, Aussenhandelsbetrieb der Deutschen Demokratischen Republik, DDR 1080 Berlin, Friedrichstrasse 61

11746
CSO: 1863/8

FUTURE OF COMPUTER HARDWARE

Tbilisi ZARYA VOSTOKA in Russian 13 Sep 81 p 3

[Article by I. Prangishvili, chairman of the organizing committee, All-Union Conference on Large-Capacity Computer Systems, academician of the Georgian SSR Academy of Sciences]

[Text] The All-Union Conference on Large-Capacity Computer Systems will open tomorrow in Tbilisi.

Such a conference is being held in our country for the first time, and so the wide interest displayed by the scientific and technical community is understandable. The number of applications to participate is many times larger than the possibilities of the organizing committee. The program committee of the conference also encountered a similar problem.

The great attention displayed toward such computer systems is determined by the fact that they are characterized by great speed, flexibility, reliability and durability, and also by relatively low cost, which is especially important for expansion of the area of their application.

The conference program includes practically all the spectrum of the most important theoretical and technical problems arising in the planning, production and use of high-capacity computer systems. Reports devoted to the most promising domestic and foreign developments in that area will be heard at the plenary sessions. There will be a general discussion of the most effective methods of increasing the capacity of computer systems. In the course of the conference four sections will work, at which about 100 reporters will speak on the following directions: the architecture of high-capacity computer systems; software; simulation and estimation of the capacity of computer systems; reliability, technical diagnosis and failure resistance.

The selection of the place to hold the conference was not made randomly. Large collectives of computer hardware specialists are working successfully in Tbilisi and there is a well-developed network of computer centers. More than 40 organizations are engaged in the development of computer hardware and the creation of software. I would like at this point to note work done at "Elva" Scientific-Production Association, at Tbilisi State University, in particular at the Institute of Applied Mathematics, at Georgian Polytechnic Institute, in the institutes of control systems, mathematics and cybernetics of the Georgian Academy of Sciences, and in the Computer Center.

In the course of the last 25 years computer technology has become a decisive factor in the economic and social spheres of development of society. The scientific and technical level of developments, the volumes of production and the scales of the introduction of computer technology in all spheres of human activity determine to a great extent the industrial and economic potential of the country. Capital investments in this sector are doubling every 5 years.

Work in the area of the organization of parallel computations has led to the creation of Soviet large-capacity systems with a contemporary architecture. At the present time high-capacity matrixes, main-line and associative systems have been developed, and also multiprocessor and multimicroprocessor systems, etc. In that case use has been made of new principles of the organization of computational processes which have permitted the creation of "families" of computer systems with extremely high technical and economic indicators. The speed of such systems reaches tens and hundreds of millions of operations per second. Problem-oriented systems, already series-produced, are characterized by a high technological level and low cost. Methods of systems programming are being developed at rapid rates; they permit creating exceptionally complex packages of programs for perspective computer complexes and systems.

Experience, the results of research and industrial developments obtained in recent years will be analyzed at the conference. But that will be only a part of its work. It is still more important to designate the paths of future research and to formulate the tasks which must be solved by us both in the next few years and in the more distant long term. This applies also to programs of basic research directed toward the formulation of a general theory of parallel computations and the search for new principles of construction of large-capacity parallel computer systems. Our task is to carefully examine the scientific work done in anticipation, to select and develop the most promising directions and to contribute in all possible ways to the rapid and complete use of scientific results in the national economy.

2174
CSO: 1863/12

NEW MEASURING AND COMPUTING COMPLEXES (MCC) BASED ON SM, CAMAC INTERNATIONAL SYSTEMS

Moscow SOVIET EXPORT in English No 5, Sep-Oct 81 pp 42-45

[Article by V. A. Shulyakovsky, chief engineer, Soyuzzagranpribor, Export and Import Amalgamation, Moscow]

[Text] The techniques of scientific and engineering experimentation are becoming increasingly intricate, the equipment involved is steadily gaining in sophistication, and research programmes in diversity. As a result, staging an experiment and processing measurement results take an increasing amount of time.

Some time ago, Computer Automated Measurement and Control systems were developed to speed up experiments and achieve greater accuracy.

Originally designed for solving problems connected with nuclear research, CAMAC systems are now being used much more extensively. Such systems are indispensable today for complicated and highly accurate experiments in physics, chemistry, astronomy, oceanography, medicine, environmental protection, aviation, metallurgy and instrument engineering.

Six Vital Problems MCCs Help To Solve

The measuring and computing complexes can save much of the experimenter's time and make his work considerably easier at all stages.

First of all, the complex can be controlled automatically at the adjustment stage. Second, the information obtained during an experiment is registered in real-time scale and processed right-away. Third, the MCC controls the entire progress of the experiment in accordance with processing results and operation algorithms. Fourth, provisions have been made for the experimenter to conduct a dialogue with the electronic computer, incorporated in the MCC, using symbolic and graphic forms of communication. Fifth, the information yielded by an experiment can be transmitted (via telecommunication channels, for instance) to higher-level computers for processing, in which case the MCC acts as a satellite. Sixth, complicated and ramified experiment automation system can be formed by means of the local MCCs and higher-level electronic computers.

The MCCs are noted for the immense diversity and broad frequency range of the signals they can pick up, high operation speed and superb accuracy of measurements. This makes up adequately for their fewer inputs and outputs, compared to automated production process control systems.

All the MCCs, manufactured in the USSR, undergo metrological tests following the procedures endorsed by the State Committee for Standards and reach the clients metrologically certified.

From General Physics to Narrowly Specialized Experiments

The measuring and computing complexes depending on the CAMAC principles for their operation vary in hardware and functions.

For instance, the IVK-1 complex, in serial production in the USSR, automates laboratory experiments conducted with general physical methods.

The IVK-3 problem-oriented complex is intended for automating experiments conducted by means of optical spectral instruments. It is successfully applied for research in physics, chemistry, biology, medicine, metallurgy, light and food industries, etc.

The IVK-4 complex automates complicated and widely variegated laboratory experiments, and makes it possible to form double-machine complexes with common peripherals, including external stores, with time-separated processors. Whenever necessary, the IVK-4 will ensure the hot reserving of a processor or any other device in the complex. Finally, the pattern plates, which are standard equipment of the IVK-4, enable the user to assemble any narrowly specialized CAMAC modules not in serial production.

In a magazine article it is impossible to deal with all the measuring and computing complexes manufactured in the USSR--their range is extremely wide. Under the programme of MCC development for 1981-1985 no less than 30 new basic complexes are to be designed for the automation of experiments, technical and medical diagnostics, strength and metrological tests.

Efficient Processes of Designing Optimum MCCs

Naturally enough, users want optimum MCC hardware. However, the great variety of converters, output signal generators and data processing units makes the synthesis of the MCC a rather complicated matter. To ensure the optimum characteristics of the complex an automated MCC designing process has been developed in the USSR.

The basic characteristics taken into account in the process include the confirmation of the object to be measured, the degree of its homogeneity, the number of measuring and control points, as well as a number of other factors (the kind of physical quantities, the measurement ranges, the threshold frequencies of the spectra, etc). Also examined are the kinds of the transducer output signals, the kind and mode of processing the data obtained, the method of its presentation (digital printing, computer graphics, displays). As a result, the complex's specifications are formulated.

The second stage is the synthesis of the structures which meet the specifications. Used for this purpose are standard structures, each meeting at least one specification, and all of them, the entire set. Since some of the structures may prove redundant, a hardware minimization procedure is envisaged.

The third stage is the analysis of the structures obtained in terms of the quality of specification fulfilment: the parametric synthesis. In the process, measurement and data processing erros are minimized, which is of great importance for the MCC. [as published]

The MCC pattern worked out in this way is optimum for the user in the great majority of criteria--and certainly in the most important ones.

The MCC Guarantees High Measurement Accuracy

The MCC units include a programme-controlled voltage calibrator and precision d.c. voltmeters. These make it possible to control the MCC's metrological characteristics with the "expanding ring" method.

During a check, the electronic computer, which is part of MCC's hardware, generates test signals in the form of digits. Further, the "ring" closes of AD input converters, amplifiers, commutators and DA converters. The check results are analysed by the same electronic computer. Thus, the standard high accuracy of measurements and of pilot signal delivery at all the inputs and outputs is guaranteed.

Basic Features of a Source of Calibrated Voltage and of One of the Digital Voltmeters

Item	Source of Calibrated Voltage	DC Digital Voltmeter
Type	F7046/7	Shch 1516
Voltage range, V	±0.1; ±1; ±10	±0.05; ±0.5; ±5; ±50
Relative error	0.003	0.01
Resistance: input, Mohms output, Ohms	--	10
output, Ohms	0.1	--

As for the data plotters, displays, timers and other devices, analysis has shown the expediency of calibrating them by using the universally accepted methods under the control of the MCC's computer.

Resistance, capacity and inductance calibrators are being developed to broaden the application of the "expanding ring" calibration method.

Extensive Software

The MCC's software is extensive enough. It makes the complex eminently suitable for solving not only specific, but background problems as well (i.e. those dealt with by the computer in spare time).

For instance, the software of the IVK-1 complex includes:

--PLOS SM--a punched tape operating system intended for preparing, debugging and fulfilling the user's programmes in the ASSEMBLER language in single-programme duty.

--DOS SM--a disk operating system for preparing, debugging and fulfilling the user's programmes in the MACRO-ASSEMBLER and FORTRAN-IV languages, in single-programme dialogue and stacked-job processing duties.

--DOS RV--a real-time disk operating system resident in the immediate-access memory. The system takes care of planning the computing process in multiproblem duty and, at the same time, of developing the user's programme in background duty.

The system also processes direct access data sets and elaborates overlay structures. Finally the DOS RV can be used to develop and run the programme of the MCC's communication with the device involved in the experiment.

--CAMAC MONITOR--a set of subprogrammes which ensure the exchange of information between the units of the SM-3 minicomputer (monitoring the IVK-1 measuring and computing complex) and the modules of the CAMAC crates (standard units). This exchange proceeds under the control of the DOS SM and DOS RV operating systems. Besides, CAMAC MONITOR enables the user to work with the CAMAC modules in FORTRAN-IV language.

--IVK-1 TESTS which help to check on the efficiency of the IVK-1 complex and its individual elements.

Besides these operating and service programmes, the complex may include:

--OS RV SM--a multipurpose real-time operating system, basically similar to DOS RV, but having a broader application. In particular, it can handle background problems in stacked-job processing and dialogue multiterminal duties.

--FOB OS--a background basic operating system intended for laboratory experiments and capable of solving two problems simultaneously--one in real time, and the other in counting or debugging conditions.

Crate Parameters According to CAMAC Standards

The CAMAC crate is used for communication with the experimental object of the control mini-computer which is part of the MCC hardware. The crate incorporates standard CAMAC modules--AD converters and other functional units. The basic crate can be easily converted into a problem-oriented one through replacing the standard set of modules with a set specifically geared to solve the given problem. The crate ensures the electric power supply to, and the cooling of, the modules.

The basic crate is in full conformity with the CAMAC standards, logical, electrical, design and technological. Plug connectors standard for the CAMAC are employed.

The IVK-2 complex is designed for automating experiments in various branches of science. It is conjugated with the unit for electronic paramagnetic radioscopy (right).

The Basic Features of Certain MCCs

Item	IVK-1	IVK-2	IVK-3
	Complex Type		
The Computing Part			
Processor, type	SM-3P	SM-4P	SM-3P
Store capacity:			
internal, Kwords	28	64	28
external disk, Mbytes	4.8	4.8	4.8
external tape, Mbytes	--	20	--
Operation speed:			
of printer, lines/min	180	500	180
of punched-tape input device, characters/sec	300	300	300
of punched-tape output device, characters/sec	50	50	50
Measuring Part			
Analogue-code converter:			
number of inputs	64	64	32
number of digits in code	10	10	10 or 14
conversion frequency, kHz	50	50	0.5 or 50
maximum input signal level, V	10	10	10
Code-analogue converter:			
number of outputs	4	4	2
number of digits in code	10	10	10
conversion frequency, kHz	100	100	100
output signal change limits, V	0 - 5	0 - 5	0 - 5
Discrete output:			
number	4	4	2
number of digits	24	24	24
Counters:			
binary, number of digits and quantity of counters	16 x 4	16 x 4	--
binary-decade, number of digits	--	--	6
Timer generator frequency, MHz (mzx.)	1	1	20
Number of step-by-step motor control channels	--	--	2
Teletype channel:			
number	1	1	--
signal level, mA	20 or 60	20 or 60	--

Note:
(1) Dash (--) means "no."
(2) The IVK-3 measuring and computing complex includes a data plotter (data plotting surface 200x300 mm, pen travel speed 75 cm/sec, accuracy 0.5%) and digital voltammeter (5 decimal digits, conversion frequency 5 kHz).

The service and auxiliary modules are necessary for checking all the crate modules in manual control duty, with control and crate mainline signals indicated. Any CAMAC instruction can be set up, and its fulfillment checked, by means of the manual controller's keys.

MCC: The Most Sophisticated Form of Electrical Measuring and Controlling Equipment

The measuring and computing complexes are capable of performing a wide range of functions and can be freely programmed. All their through metrological characteristics are normable, no matter how many elements of any complexity such an electronic circuit might contain. All this ensures an ever broader usage of measuring and computing complexes.

CSO: 1863/28-E

RIGA VEF ASSOCIATION DEVELOPS OUTSTANDING MICROCOMPUTER SYSTEM

Moscow PRAVDA in Russian 20 Sep 81 p 3

[Article by V. Stefanovich, Riga: "Microcomputers Do the Controlling"]

[Text] Microprocessors, the brains of the latest computer technology, are causing a true revolution in engineering, maintenance, and control. The systems based on them are efficient and at the same time relatively inexpensive means of monitoring and controlling intricate complexes both in research and production and in the sphere of social and everyday services.

It is precisely these systems, specialists believe, that will largely define the frontiers of technical concepts aimed at significantly raising labor productivity in various fields in the coming decades. This path was also taken by the builders of microprocessor systems at the Riga VEF Association imeni V. I. Lenin.

The universal systems they have devised with help from specialists of the Latvian SSR Academy of Sciences and higher educational institutions in the country include all the necessary elements of hardware and software. They are based on standard microprocessors developed and manufactured by the VEF Association and consist of a series of fundamentally new microcomputers with built-in black-white and color displays, cassette storage, data transmission devices, and keyboards. The systems include a broad assortment of standardized units for linkage with objects to be monitored and controlled.

The motivation to devise microprocessor systems came from the need to make a qualitative improvement in the production of telephone switching equipment. The coordinate automatic telephone exchanges were replaced by quasielectronic ones controlled by microcomputers. The new automatic telephone exchanges have great potential. Suffice it to say that they offer users 37 types of services. To accomplish this the VEF Association invented and built microprocessor dialogue systems for diagnosis and debugging of the functional units of quasielectronic automatic telephone exchanges. The total economic impact was more than 30 million rubles. Working conditions improved noticeably. Labor productivity rose by 10 times in certain production operations.

The advantages of these systems are flexibility, precision and reliability in work, easy adaptation to different, even highly complex, production installations (radio receivers, amplifiers, radio-tape recorders, and the like) in which hundreds of parameters must be measured, as well as to different service spheres (public catering enterprises, stores, sports competition, and the like). The modular principle of design broadens the "flexibility" and area of use.

The VEF microprocessor systems are built according to a uniform design-technological principle, and for the first time in our country program means to realize these systems have been formulated. The hardware meets the world standard and in many cases surpasses it. This is illustrated by the 39 foreign patents and author's certificates.

The system for evaluating quality of labor displays information on monitoring results and prints a corresponding report. At the same time it classifies defects, analyzes why they occurred, and establishes where they occurred. This information is displayed on panels for the work position, brigade, and section.

Production is not the only place these systems are used. Employees of the association enjoy their services at many eating places and shopping sites, purchasing products both with cash and on credit. This can be done simply by feeding the number of the employee's plant pass into the system. Then information on the customer, the amount of his credit, and the purchase, for example suppose it is one of the three choices for dinner, is transmitted to the microprocessor system and then to the computer center. Even at peak times now customers at the plant dining hall can be served in 2-4 minutes, and the possibility of making purchases at the plant without standing in line saves time.

The VEF workers have developed the Gimnast-2 microprocessor system for controlling athletic competition; there is nothing like it in world instrument making. The system includes eight microcomputers and more than 200 other units of hardware in its computer network. The system was tested during the 22nd Olympic Games. The International Federation of Gymnastics recommended that this system be used in the upcoming world gymnastic championships in Moscow.

The work of the Riga association has been discussed at the scientific-technical societies of Radio Engineering, Electronics, and Communications imeni A. S. Popov and of Instrument Making imeni Academician S. I. Vavilov. Participants in the discussions had high praise for the developers of the system and nominated it for the USSR State Prize.

11,176
CSO: 1863/19

TWO-PROCESSOR COMPLEX PASSES TESTS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Sep 81 p 2

[Article by M. Yeremyants, Yerevan]

[Text] State tests of a new two-processor complex created by scientists and specialists of the Yerevan Scientific Research Institute of Mathematical Machines have been successfully completed. One more important step has been taken in the development of Soviet computer technology.

...Today there is quiet in this room--it's an ordinary peaceful working day. At the panel of the complex only the chief engineer Martyn Markaryan and the sector chief Karlen Akopyan are on duty. It seems as if all those stressed days and nights, when both the developers and the members of the commission for several days in a row sent in quite different programs, gave the complex very complicated tasks and followed the course of their solution, had never been.

Today all that is behind us. Signatures have been affixed and documents have been put in portfolios. The conclusions of the commission are unanimous: the test was rated "excellent." And now without danger of exerting pressure it is possible to question the chairman of the state commission, Doctor of Technical Sciences V. Levin.

"In our age of the computer it is difficult to be surprised: they are used in practically all spheres of life," he says. "But there is a group of tasks--administrative, production and scientific, in which special computers are required, with maximum speed and reliability. But how are those high qualities to be achieved? We have already practically arrived at that invisible line where all attempts to curtail the time required to complete each operation rest upon the rate of propagation of the signals themselves. There is one way out: those operations must be distributed between several devices.

"Any computer has two important component parts: a memory and a processor--that is the computer nucleus itself which, strictly speaking, also determines the speed of operations and the computer productivity. The new complex has two such nuclei! And they are organically combined into a single device.

"The signals on the panel say little about this to the uninitiated. But the operators see how the control program automatically distributes the flow of computational

operations between the two processors or at the required moment adds their capacities, how vigilantly it traces "viability": the failure of one of the processors does not lead to stoppage of the entire complex."

"And now you see how it corrects its own errors," says the chief designer of the complex, Doctor of Technical Sciences A. Kuchukyan, showing new means of diagnosing defects.

"The complex was created on the basis of the YeS-1045 computer. That selection was no accident--machines of the YeS constitute the basis of the industrial output of computer hardware in our country. Specialists of the Scientific Research Center of Electronic Computer Technology (NITsEVT) have correspondingly become partners of the Yerevan scientists. At the same time as the scientific associates of the Yerevan Scientific Research Institute of Mathematical Machinery developed the hardware, their colleagues from NITsEVT created the operating system. As a result for the first time in our country a two-processor complex acquired a high productivity--1.7 million operations per second!"

"Until recently there was only discussion of the advisability of multiprocessor complexes," says the director of the institute, M. Semerdzhyan. "And now successful tests in practice have shown the possibility of creating them and their high efficiency. It is not just a matter of speed; in comparison with the YeS-1045 the new complex has 10 times greater reliability!"

"The new development is a unique logical completion of the complex program of the institute, directed within the framework of the Single Series toward the creation of computers of medium capacity and complexes based on them. In the last 4 years the YeS-1045 computer, the YeS-1045.01 matrix processor, a two-machine computer complex and, finally, this two-processor complex have come into being. What further?"

"Routine problems, complex tasks and new machines," replies M. Semerazhyan. "For this time it is already a new generation."

2174
CSO: 1863/12

KUBYSHEV AUTOMATED SYSTEM SUBDIVISIONS PROVING EFFICIENT

Moscow EKONOMICHESKAYA GAZETA in Russian No 38, Sep 81 p 12

[Article by S. Yakubovich, chief of the information and control center of the Zavod imeni Maslennikov Production Association, Kubyshev: "Cost Accounting in the Subdivisions of the Automated Control System"]

[Text] The questions of the organization and structure of the technological processes of collecting, preparing, and processing data and operating computers have been rather thoroughly worked out by now, but the questions of organizing cost accounting in ASU [automated control systems] subdivisions of a production association have not been adequately resolved. The principal line of action in this work is the search for improved systems of cost accounting indicators of the ASU production units taking into account the specific features of the organizational and economic status of the subdivisions and making the indicators more effective by matching them with new challenges.

Specialists will likely be interested in the experience of our Zavod imeni Maslennikov Production Association in Kuybyshev. We have worked out and introduced cost accounting in ASU subdivisions. It is organized on general cost accounting principles.

The output is considered to be the information in various types of services (operating peripheral equipment, communications equipment, electronic equipment, and so on) as well as the nonstandard ASU means fabricated.

Cost accounting relations among production subdivisions and ASU subdivisions are organized on the basis of ratified plans of work, job requests, and schedules. They envision payment for the ASU "output" (information, services, and devices manufactured) necessary to support control of the organization of production and industrial processes. Payment is made in conformity with ratified prices for all types of jobs.

Establishing technical-economic norms is, we feel, the most important basis for organizing cost accounting. This is indeed an advantage of our system. We develop operation-labor norms for all types of work, including the work of designers, programmers, planners, and other specialists. Price lists for output were also drawn up and norms for use of materials and purchased assembly

components were established. The norms of the Central Statistical Administration and State All-Union Standards were taken into account here.

All work is clearly regulated by the statute on cost accounting in ASU services, which reflects all facets of the activity of these services and gives techniques for calculating production programs, writing up estimates of production costs, calculating costs per unit of output and jobs, and procedures for accounting and reporting.

Material incentive is provided on the basis of a system of bonus indicators for prompt and high-quality performance of production assignments. Within this system each category of employees has its own indicators, which are interrelated with the general indicators of the collective.

We must say that the introduction of cost accounting in ASU subdivisions demands additional labor-intensive work related to planning, accounting, monitoring, and analysis. We worked out algorithms and packages of applied programs to solve these problems by computer in order to avoid an increase in the number of ASU subdivisions when cost accounting was introduced.

If we consider the cost accounting activities of the ASU services we can see two positive aspects. The first is that information is no longer "ownerless," that is, such that no one knows who is supposed to pay for it, even though expenditures for data processing make up a significant part of the prime cost of output. They are "hidden" in overhead expenditures (shop or general plant overhead) and do not receive a clearcut expression in the way that electricity, steam, and water do. Therefore it is difficult to monitor and regulate them.

When cost accounting is introduced in ASU subdivisions it becomes possible and necessary to allocate expenditures for data processing more or less precisely to those shops and those articles for which information is processed. This reduces information that is surplus, ordered "just in case." This means that expenditures go down and savings occur. In this situation it is possible to envision expenditures when writing up cost calculations and prices for output.

When the question is formulated in this way it becomes simpler to evaluate the efficiency of introducing computer technology. It is no longer necessary to single computer technology out from other fixed capital, and it becomes possible to judge the efficiency of use of computer technology by qualitative criteria of overall enterprise activity, not by quantitative (quite crude today) indicators in rubles.

The second advantage of cost accounting in ASU subdivisions is that workers strive to reduce costs and raise labor productivity, because ultimately their wages depend on it. At the same time the efforts of many people, practically the entire collective of the cost accounting subdivisions, are actively involved in the search for reserves in many areas. No one today is trying to increase the number of employees, as was true earlier, and the labor of categories of workers such as computer operators and electronics engineers is regulated by norms.

Specialists think more about how to cut problem-solving time and at the same time not reduce the average normative loading of the computer. They search for and rapidly introduce new problems that are efficient from all standpoints. The employees of the production base try to have a large file of orders in order to be certain that the personnel and equipment are fully loaded.

There is one more important matter. The efficiency of use of YeS [Unified System] computers has improved sharply. Operations such as feeding data on machine media and printing output documents, which are inefficient for a large computer, are done on small computers such as the M5000 while the YeS computer uses its "brains" in the multiprogram mode.

Now let us look at the concrete results. The work of the last two years has enabled us to double the efficiency of use of YeS computers, lower the labor-intensiveness of programming ASU problems by 20-25 percent, automate the system for keeping technical and working documents, improve its reliability, reduce the labor-intensiveness of document preparations, and reduce the time required for document development by a factor of 10. The exchange of ASU documents among associations has also been stepped up, because only magnetic tape is transferred today.

The lowering of costs for data processing in ASU subdivisions ultimately has an impact on lowering the prime cost of output produced by the association. Perhaps the main thing is that the lowering of costs and growth of labor productivity in the ASU services ensures continued development of the ASU itself.

We have accumulated our first experience with development and introduction of cost accounting in the ASU subdivisions of industrial enterprise. It is entirely understandable that we still have many unsolved problems and still have a great deal to do. But one thing is undoubted — this kind of cost accounting is a very important and necessary task and it should be disseminated widely.

11,176
CSO: 1863/19

REPAIR OF INTEGRATED CIRCUITS

Tallinn SOVETSKAYA ESTONIYA in Russian 24 Jun 81 p 3

[Article: "Repair of Integrated Circuits"]

[Text] Defects in microelectronic devices can be eliminated by means of a laser beam focused on a point measuring 5-7 thousandths of a millimeter. This was proved by experiments of scientists of the Institute of Solid State Physics, Latvian State University imeni P. Stuchki. They used the light tool to "repair" integrated circuits on which modern computer equipment is based.

The innovation permits annealing of individual particles of the circuit, changing the parameters of failed components and thus makes it possible to restore normal operation of the miniature structure.

Man has never been able to carry out such precise manipulations with a laser beam. A special installation was developed for this at the institute. It automatically finds and corrects damage in integrated circuits according to a given program. Both scientific laboratories and enterprises of the electronic industry need these types of installations.

6521
CSO: 1863/240

UDC 681.327.12

SENSORY-TYPE CONSOLE FOR OPERATIONAL DATA FEEDING TO GRAPHIC DISPLAY UNIT

Kiev MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 3, Jul-Sep 81 (manuscript received 14 Jul 80) pp 47-49

[Article by A. I. Chebarev, V. S. Bagdasaryan and A. N. Sagoyan, candidates of technical sciences, and A. A. Amirdzhanov, D. L. Kamalova, I. V. Levitskaya, E. N. Farzane and G. V. Sefilyan, engineers]

[Text] The introduction of up-to-date data display systems in automated control systems for industrial processes requires that new technical means be devised for human interaction with the computer and the information display module. Therefore, a great deal of attention is being given today to the search for new principles and refinements of already-known principles of constructing operational data feeding devices, in particular sensory devices [1], which most fully meet the psychophysiological and ergonomic requirements of human dialog with the data display system.

The Azerbaijani Institute of Petroleum and Chemistry has developed a sensory console for feeding alphanumeric and service information to a graphic display unit, a colored graphic display that shows the mnemonics of chemical production [2]. The console is one modification of the sensory-type units built with series 155 transistor-transistor logic (TTL) integrated circuits and designed to feed operational data to the graphic display unit of the automated control system for the industrial process of producing weak nitric acid and ammonium nitrate, and also for feeding functional instructions when using the light pencil and pen.

The console allows feeding 60 letter, number, and character instructions and 30 functional instructions and issuing potential signals in the standard KOI-8 code with a check bit to the graphic display unit and computer. It has a buffer memory with a volume of four symbols. The raw data is fed through the keyboard, in which the code is formed when the operator touches the corresponding key. Each key of the console is connected to its own sensory convertor that responds to the human action and recognizes the touch [1, 3].

The operating principle of the sensory convertor is based on use of signal capacity leakage through the human body. The instantaneous leakage makes it possible to produce an information signal when the operator touches the key.

An "And-Not" TTL gate is used to convert the operator's touch into an electrical signal. If positive pulses are fed to one input of this circuit and the other remains free (floating), its parasite (installation) capacity is quickly charged by the input current of the emitter junction. As a result, a high signal level also occurs at the floating output of the circuit, which corresponds to a low output level on the "And-Not" circuit. But if the operator touches the floating output with a finger, this will introduce capacitance of some 70 pf [4]. In this case, with a short positive pulse of 50-100 ns, capacitance is not able to charge to a high level corresponding to logical "one," or to a high signal level at the output of the "And-Not" circuit. Thus, a binary signal is produced whose level corresponds to the absence of touching, while a high level indicates that the operator has touched the key.

A K155KP7 selector-multiplexor is used to convert the operator's touch into an electrical signal. Its floating leads have different charging currents and mounting (stray) capacitances which can be explained by the range of microcircuit parameters and the arrangement of the keys on the console. In this case the different lengths of the mounting and connecting wires make it necessary to adjust the keys individually. This is done by means of resistors connected in between the floating lead and the power supply lines. The charging current of the capacitance of the contact areas is lowered by the presence of resistors. This makes it possible to regulate the permanent charging time and increase the frequency of use of keys by lowering the capacitance discharging time. Studies have indicated that where the multiplexors are appropriately arranged relative to the data input keys, which are usually in a strict order, the length of the mounting connection wires between the keys and the multiplexor input does not exceed 20 cm, so the same resistance was selected for all line resistors: 6.2 kiloohms.

Because the basic operating condition of this sensory convertor is that the human capacitance significantly exceeds the installation (stray) capacitance of the floating "And-Not" output circuit, when the key query pulse has ended it is essential to insure that the capacitance of the contact area which the operator is touching discharges. Because the leakage current between the emitters is very small, just 10-20 nanoamperes, the switching circuit provides a high duty ratio for the query pulses of the "And-Not" circuit which performs the conversion function.

Figure 1 below shows a functional diagram of the console.

Power is fed from pulse generator D1 to counters D2 and D5. The code of counter D5 proceeds to multiplexor D14 whose inputs D1, D2, ..., DK are connected to keys K1, K2, ..., KK. Counter D2 and decoder D4 produce four cyclical pulses in each cycle of reference to the key. The transfer pulses go from counter D2 to coincidence circuit CxC D7 to the counter input of delay element D9, which is a binary counter. As soon as "1" appears in the high-order bit, the feeding of pulses to input D9 stops (a cut-off potential goes to input D7), and the feeding of pulses to the input of counter D5 through CxC D3 will be permitted.

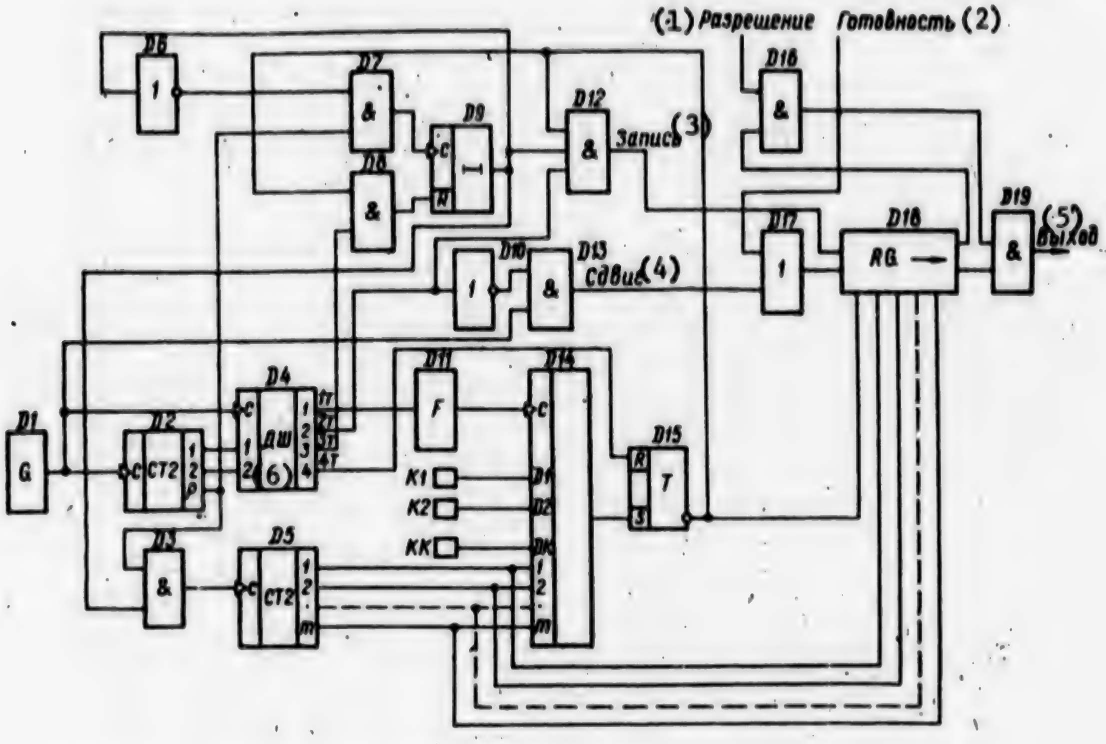


Figure 1. Functional Diagram of the Operational Data Feeding Console

Key: (1) Permission;
(2) Readiness;
(3) Entry;
(4) Shift;
(5) Output;
(6) Decoder.

The first cyclical pulse produced by D4 goes to the input of shaper D11, which forms a short pulse of about 50-100 nanoseconds. This pulse is fed to the input of multiplexor D14 as a strobing pulse. If the key is not touched, a short pulse appears at the output of multiplexor D14 and switches the trigger of D15 to the state "1." In this case a "0" goes to the CxC D8 and D12. This does not permit the production of a record pulse at output D12 or a clear pulse at output D8. The fourth cyclical pulse clears trigger D15 to "0."

If the operator touches any key, a pulse does not appear at the output of the multiplexor when the first cyclical pulse is produced and trigger D15 remains in state "0." The second cyclical pulse scans CxC D12 and produces a record pulse which goes to buffer memory D18, which is a shift register. In this case the code of the key which the operator touches is recorded in the shift register and the state of the contact trigger D15 is also registered.

The third cyclical pulse goes through CxC D8 and clears counter D9 to "0." As a result, a cut-off potential goes to CxC D3 and stops the feed of pulses to the input of counter D5. As a result, the code of the key which the operator

touched is kept on counter D5. At the same time an authorizing potential comes to CxC D7 and permits transfer pulses from counter D2 to fill D9.

The fourth cyclical pulse holds trigger D15 in state "0."

In the next cycle the circuit works in a manner similar to that described above. But now multiplexor D14 will refer only to that key which the operator touches. In the second cycle the record pulse will not be produced because a cut-off potential arrives at D12 from D9 before the operator touches the key.

When the key is touched a jar is possible and, like industrial interference introduced by the human being upon touching, may be perceived by the circuit. This will result in filling counter D9. But each third cyclical pulse, arriving at the moment when the circuit has recognized the existence of a touch, clears counter D9 to "0" and it begins to fill again. The delay time of element D9 should be selected so that counter D9 does not refill when a key is touched. As soon as the touching of the key stops, counter D9 will fill and as a result the arrival of pulses at its input will stop, while beginning again at the input of counter D5. Thus, the circuit returns to its initial state and will work in a manner similar to that described above.

The information recorded in register D18 is shifted by shift pulses in each cycle except the second cycle, when the code of the key is recorded. This is done by the "Not" circuit D10 and CxC D13. As soon as the state of trigger D15, which characterizes a touching of the first key, is shifted in register D18 to the high-order bit, an authorizing potential will arrive at CxC D16 to characterize the presence of information in RG-D18.

With the arrival of the "permission" signal from the computer, CxC D16 forms the "Cosole Ready" signal and sends it to the graphic display unit. Following this signal the code recorded in register D18 is read through CxC D19 and sent to the computer.

The buffer memory D18 can store four words. In the absence of the "Permission" signal, data being fed is accumulated in buffer storage. When it is full the "Overflow" light on the console goes on, warning that data feeding must be stopped. When the "Permission" signal arrives information is read out of buffer memory and the "Overflow" light goes out. Upon completion of reception the "Permission" signal is erased. In terms of design the console is a movable instrument 440 x 220 millimeters in size (see Figure 2 below). The back of the unit is 75 millimeters high, while the front is 59 millimeters; in other words, the face of the console is slightly tilted. An alphanumeric keyboard with an elongated space bar is arranged on the face of the console together with the functional keys for service instructions. Furthermore, the power supply switch is mounted on the front of the console and has a light that

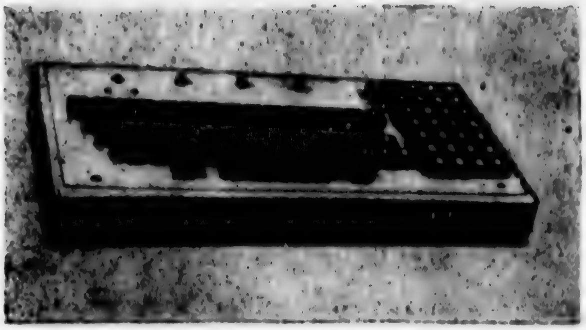


Figure 2. Appearance of the Console

indicates when the power is on; in addition there are indicator lights that signal an overflow in buffer memory and tell whether the alphanumeric keyboard is in the upper or lower register. The sockets for connecting the unit to the graphic display unit and computer and also to the power source are located on the back of the console. The connecting wire can be up to 10 meters long. Because the console operates on the basis of scanning all the keys, one of the basic technical characteristics of the console is maximum speed of data input, which is 23 key touches per second with a maximum delay time per jar of 5.55 milliseconds.

Potential code signals whose levels correspond to the series 155 TTL elements are pulled from the output of the console, so it is easy to connect the console with the display processor of the Elektronika-60 microcomputer. The electrical circuit of the console consumes seven watts of power. All of the units of the console conform in design and technology to the YeS [Uniform System] of computers.

FOOTNOTES

1. V. Ye. Skhabyuk, "Sensory Control in Human-Computer Interaction," PRIBORY I SISTEMY UPRAVLENIYA 1979, No 6, pp 4-5.

2. G. V. Sefil'yan, and L. A. Kocharyan, "Color Display for the Mnemonics of Chemical Production," in "Tezisy Dokladov I Zakavkazskoy Konferentsii Molodykh Spetsialistov i Uchenykh 'Razrabotka i Vnedreniye ASU TP v Tsvetnoy i Chernoy Metallurgii, Khimicheskoy, Neftekhimicheskoy i dr. Otraslyakh Promyshlennosti" [Abstracts of Reports of the 1st Transcausian Conference of Young Scientists 'Development and Introduction of Industrial Process Automated Control Systems in Ferrous and Nonferrous Metallurgy and the Chemical, Petrochemical, and Other Industrial Sectors'], Dilizhan, 1977, pp 80-81.

3. A. I. Chebarev, "Principles of Construction of Dialog Devices Based on a Tactile Information Signal Shaper," in "Annotatsii Soobshcheniy VII Vsesoyuznogo Soveshchaniya po Problemam Upravleniya" [Notes on Reports at the 7th All-Union Conference on Control Problems], part 3, Minsk-Moscow, 1977, p 38.

4. A. I. Chebarev, and A. A. Amirdzhanov, "Investigation of Change in the Parameters of an Oscillating Contour Acted upon by a Human Operator," UCHENYYE ZAPISKI AZINEFTEKHIMA, Series IX, 1976, No 7, pp 101-106.

11,176
CSO: 1863/14

NEW BULGARIAN OFFICE COMPUTER OFFERED FOR SALE

Kiev MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 3, Jul-Sep 81 back cover

[Advertisement]

[Text] Isotimprex Foreign Trade Association is now exporting the IZOT 0250 office computer, a machine for processing economic data that has excellent technical-economic indicators and high computational speeds. The office computer is built with MOS integrated circuits with a high degree of integration. The set includes a memory unit on a floppy magnetic disc which permits secondary processing of information in a mini-computer or computer.

Specifications

1. Control Unit

Memory Volume, kilobytes:

Main Memory with 10 Constant Registers 12
Permanent Memory with 512 Independent Digital Registers and 256 Text Registers 18

Arithmetic Operations- Addition, Subtraction, Multiplication, Division, Computation of Percentages

Bit Configuration . . . . 14 Bit Positions

Display:
Digital: . . . . For feeding data and intermediate results
Service . . . . For recording the state of the system

Keyboard . . . . . . Alphanumeric (Latin and Slavic), service, and digital

2. Printer (with replaceable printing disk and tabulator)

Printing Speed on Punched Paper and Blanks	30 Characters/Second with 156 Characters in a Row Using Paper 380 Millimeters Wide

3. Floppy Magnetic Disk

Capacity	250 k for One Diskette
Number of Tracks	77
Power Supply Voltage	220 volts, 50 hertz

Programming is done in a special problem-oriented language (with a translator).

The exporter is the Izotimpex Foreign Trade Association, Sofia, Bulgaria Ulitsa Chapayeva, 51; telephone 73-61; telex — 022731, 022732.

11,176
CSO: 1863/14

COMPUTERS BECOME INTELLECTUAL

Riga SOVETSKAYA LATVIYA in Russian 21 Oct 81 p 4

[Article by correspondent S. Il'icheva]

[Text] The capabilities of electronic computers are truly diverse. Cybernetic scientists are finding ever newer possibilities of making electronic brains solve very unexpected problems, it would seem.

Our correspondent, S. Il'icheva, asked G. G. Gromov, head of the video terminals laboratory, Institute of Electronics and Computer Technology, Latvian SSR Academy of Sciences, candidate of technical sciences, to tell how the computer is obtaining the ability to "see" the micro- and macroworld and thus render substantial help in solving many scientific and national economic problems.

"In our day a large number of intellectual acts and operations, for centuries considered a monopoly of man, are gradually being transferred to electronic computers. Machine methods of collecting, systematization, storage, processing and use of scientific, technical, production and economic information falling upon us in enormous quantities have to a great extent automated the intellectual work of people today.

There are machines capable of directly "hearing" human speech, there are some (and there are very many of them--of different classes and generations) which work according to programs placed in the electronic brain of the computer by man. But there is a possibility of helping the machine to "see" the micro-and macroworld, to measure and count many thousands of objects in a fraction of a second. Instruments for the analysis of micro-objects in scientific investigations and in industry, constructed on the basis of the principles of computer-aided scanning systems of optical microscopy, have become such unusual eyes of the electronic computer. For the development of those principles and instruments a group of Soviet scientists headed by Academician G. N. Frank was awarded a State Prize of the USSR in 1978. The group of laureates included Academician of the Latvian SSR Academy of Sciences E. A. Yakubaytis and his colleagues I. K. Al'yen and V. A. Yanson, heads of groups of the Laboratory of Video Terminal Complexes of the Institute of Electronics and Computer Technology of the Academy of Sciences of our republic.

The first laboratory prototypes of instruments capable of perceiving images were constructed in collaboration with the medical men of our republic about 15 years

ago. At first there was "TASI"--one variant of a television analyzer of the structure of images, intended for the diagnosis of oncological diseases. In subsequent years several additional devices were created, for various purposes and known under various names. One of the modifications received a gold medal at an international fair in Bulgaria. A video terminal from the same series was demonstrated in 1976 at a Soviet exhibition in Milan. Each of the instruments differed by a certain degree of efficiency.

In 1978 the Latvian "Rastr" was presented to the USSR Committee for State Prizes. A fairly universal cybernetic device, a complete video system capable of solving not one but several tasks, and not just medical. It can help botanists in the classification of plants by the characteristic shapes of leaves, astronomers in the analysis of sections of the starry sky, etc. If such a system is connected to a computer, the computer acquires "eyes."

Now 3 years have passed. The "Rastr" has been improved still more. Now it has grown into a video-information complex. What is the complex capable of now?

In biology and medicine it can be used for investigations of extremely small objects, for example, cells, and is capable of recognizing them in biological preparations and of improving the quality of X-ray and other photographs.

In metallography and mineralogy the complex is capable of exceptionally rapid and high-quality help in investigations of slides of various metals, minerals and materials, and even in the creation of methods of their quantitative analysis. It is interesting that it is able to draw black-and-white and colored animated films with a light pen directly on the screen of a monitor. This can perhaps produce a complete revolution in animation work. The animator seats himself and on the corresponding scenario and through a scanning optico-mechanical system etches a whole film with a light pen on the target of a transmitting television camera. Of course, this is only possible theoretically as yet. For the video-information complex is unique. It exists only in the institute laboratory. Evidently, however, such technology for the creation of "animation" is a matter of the not so distant future.

And in general, speaking dry scientific language, the new complex is intended for the solution of a broad class of problems connected with the storage, processing, transmission and recognition of video information. It starts with an optico-mechanical system to which an optical or electron microscope is connected, on the object stage of which microscope is placed a section of living tissue or mineral, etc, depending on what we want to investigate. A telescope directed toward a certain section of the sky can be set up instead of a microscope. Finally, instead of a microscope or telescope, a photographic attachment can be used. The optico-mechanical system will transmit an image to the target of a transmitting television camera. And so, in turn, black-and-white or colored images of investigated objects are transformed into a video signal which arrives on the video terminal. It once again transforms the image, but into numbers, assures an interactive mode of operation of an operator with the complex and communication and interaction with an SM-4 computer, measures the geometric and optical dimensions of the object, searches for those objects in the field of "vision" of the television camera and recounts their quantity. And then one can see on the monitor the image of the object or the numbers into which it has been converted. The latter are transmitted to the machine

through the coupler with the SM-4 computer, the interface. The computer stores and processes the obtained information, coordinates the work of the entire complex and controls the functions of the video terminal. During work with images (and there can be a large number of them) the SM-4 must have a maximum volume of ready-access memory--256 kilobytes.

The basis of the video terminal is a powerful electronic brain, the processor, to the channel of which up to 64 different peripherals, standard and non-standard, can be connected. For example, a light pen, units for various purposes, including amplifying and correcting video signals measureing area, the perimeter, the number of objects, etc.

It is difficult and perhaps impossible to enumerate all areas of applicatio of such video information complexes. One thing is clear, they open up enormous prospects in any area of the economy, science, culture and criminal law, they can take upon themselves immeasurable labor on the processing and investigation of very varied information and objects, whether they are cells of a living organism, quality control of industrial and agricultural products, study of cosmic objects, dactyloscopy, and much, much else.

2174
CSO: 1863/31

UDC 681.327.023

SOME FUNCTIONS AND STRUCTURES OF INTELLIGENT INFORMATION FORM CONVERTERS

Moscow UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 4, Jul-Aug 81
(manuscript received 27 Feb 81) pp 59-63

[Article by Igor' Semenovich Yeremeyev, candidate of technical sciences, and Andrey Ivanovich Kondalev, doctor of technical sciences, Institute of Cybernetics, UkSSR Academy of Sciences, Kiev]

[Text] In present-day simulating and control systems the transmission of initial data is accomplished by continuous and discrete signals with a large list of parameters. The striving to use the resources of the central processor of systems for processing those signals involved increase of the relative cost of programming (cost per instruction [fig 1]) [1]. This stimulated the development of peripherals capable of accomplishing some functions of a central processor and by the same token unloading the latter.

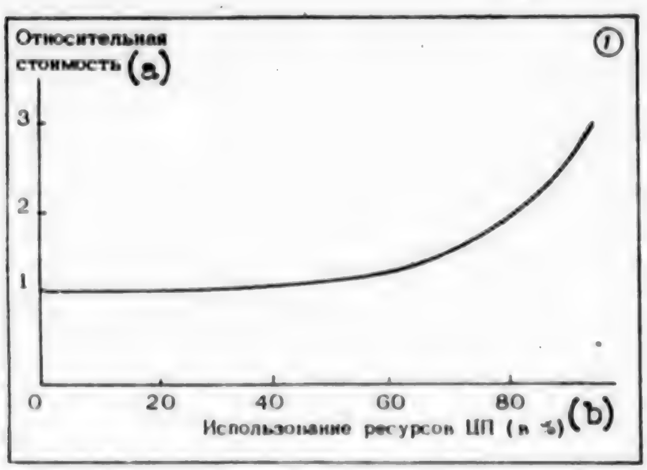


Figure 1. The relative cost of programming as a function of the percentage of use of central processor resources
a -- Relative cost
b -- Use of central processor resources (as percent)

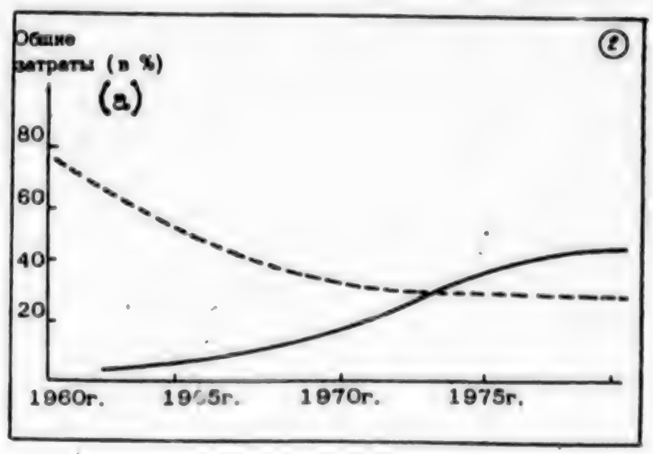


Figure 2. Variations of the distribution of expenditures on central processor and terminals in creating systems during 1960-1980 (— terminals, ··· central processor)
a -- Total expenses (as percent)

The redistribution of expenditures on the central processor and terminals in the last 20 years, caused by the tendency to increase of the "intelligence" of the peripherals and terminals is shown on Figure 2 [2]. This process completely affects information form converters, which in a number of cases can be regarded as terminal equipment. It should be noted that at present the functional possibilities of connected processors of computers are being expanded, in particular, when additional analog-to-digital units have been introduced into the channel of direct memory access, the tasks of the information form converter, the digital filter and devices for data compression and regeneration can be placed on the latter.

However, the development of intelligent terminals, as of intelligent computer channels, at first was held back by the high cost and large dimensions of the equipment. The successes achieved in recent years in microprocessor technology, especially in the creation of single-chip microprocessors, have provided the conditions necessary for a qualitative jump in the development of information form converters and their transformation into passive devices in the computing and data-processing subsystem, devices capable of processing data directly at the place where it is generated, presenting the results in a form characterized by maximum meaningful content and a high degree of reliability. The presence of a developed memory and fairly powerful computing and logical facilities, together with effective software, permits classifying such computing and data-processing subsystems as intelligent information form converters.

Intelligent information form converters can provide the following types of data processing [3, 4]:

--adaptive selection of information from sources and adaptation to the range of conversion;

--converted data filtration;

--approximation of filtered data for their economical arrangement in the memory;

--optimum coding of approximated data;

--assurance of a high degree of reliability of output data during variation of factors external in relation to intelligent information form converters, and monitoring of its own state.

An obligatory condition in that case is compatibility of intelligent information form converters with the nucleus of the information system as regards signal parameters, the data format, methods of access and data exchange. In addition, in a number of cases intelligent information form converters must vary their characteristics and structure with respect to both instructions stored in their memories and an instruction from the nucleus of the information system or operator [3].

During synthesis of an intelligent information form converter it is necessary to analyze and substantiate:

--selection of a set of procedures which are rationally executed by means of information form converters during functioning of the system;

--the required hardware;

--the basic software, which takes into consideration the functions executable by intelligent information form converters and the possibilities of expanding them;

--structures of intelligent information form converters with consideration of specific working conditions, the assumed limitations and special requirements.

Let us examine each of these tasks in greater detail.

Selection of a Set of Procedures. Procedures executable by intelligent information form converters can be divided into the following groups: selection, filtration, functional processing, approximation and optimum coding.

Selection procedures are called upon to provide adaptation of intelligent information form converters to flows of messages variable in intensity and importance to maintain optimum frequency of selection in each of the channels connected with data sources and an optimum dynamic range. Classifiable as basic procedures of this group is determination of the value and sign of the differences between the values of signals at a given moment and in the preceding step of selection in the corresponding channels, and also of the differences between signals in one and the same step in different channels and the realization on that basis of procedures for searching for the optimum, extrapolation, etc [3,4].

Algebraic averaging [5], digital filtration, smoothing and interpolation [3,4,6] can be classed as filtration procedures that assure separation of the useful signal on a background of noise.

Functional processing procedures are intended for linearization of the nonlinear characteristics of sources of input signals, and also the production of a complex signal on the output of the intelligent information form converter, which is a function of one or several input signals. Classifiable as the basic procedures of this group are square root extraction from the value of the signal, multiplication, division and addition of functions, search for the optimum, some procedures connected with statistical processing and operations of binary and multiple-valued logics [3,4].

The purpose of approximation procedures consists in a simple and compact representation of information in the memory of an intelligent information form converter. Classed as approximation procedures is replacement of a complex function by its approximation in the form of a polynomial or a series with a limited number of terms, piecewise-linear and piecewise-nonlinear approximation and regression analysis [4].

Finally, efficient coding procedures are intended for more compact representation of the data set on the output of an intelligent information form converter. Classifiable as those procedures are convolution procedures, which assure the recording of multiply encountered data or fragments of them, or data units linearly dependent on them [7].

Hardware. In the selection of hardware consideration is given to such criteria as cost, interference immunity, reliability, dimensions, power consumption, working temperature range, speed, power source requirements, the possibility of modification and expansion of functions of intelligent information form converters, compatibility with the nucleus of the system, etc. Most of those criteria are best satisfied by microcomputers and microcomplexes of large-scale integrated microcircuits made on the basis of complex metallic oxide conductor technology, which include the family of "ELEKTRONIKA NTs" microcomputers, in particular the single-chip

"ELEKTRONIKA NTs 80-T" microcomputer and the "ELEKTRONIKA NTs 8001" single-chip microcomputer based on it, and also large-scale integrated microcircuit sets of the series K-587, K-537RU1, 564RU2, etc [8].

Orientation toward the "ELEKTRONIKA NTs" family of microcomputers has its advantages. For example, the standardized interface of these computerss is an expansion of the "Obshchaya shina" ("Common Bus") interface of the SM computer, and this permits use of intelligent information form converters in the composition of systems and complexes based on the SM computer.

Basic Software. Intelligent information form converters should be regarded as problem-oriented subsystems with a standard set of hardware and an interchangeable set of programs (permanent memory modules) corresponding to a specific application and assuring implementation of all the procedures and service programs characteristic of the given class of intelligent information form converters. The basic package of applied programs of intelligent information form converters must include the following programs (modules): spectrum analysis, statistical data processing, data compression, computation of logarithms and trigonometric functions, extraction of roots, interpolation, smoothing, filtration, search for the optimum, etc.

Structure of Intelligent Information Form Converters. Various structures of intelligent information form converters are possible as a function of the level of "intelligence," problem orientation, the requirements for fail-safety and other characteristics. One of them, based on the use of microprocessor sets of large-scale integrated microcircuits and the principle of microprogram control, is presented on Figure 3. Here the microinstruction unit is constructed on the basis of a semipermanent memory unit, the instruction words of which were developed on eight separate fields controlling separate subsystems. The analog-digital (AD) converter constructively includes a digital-analog (DA) converter, the output signal of which, besides functions of a feedback signal for the AD converter, also performs the role of an input signal for the demultiplexer. A programmable operational amplifier in the given structure performs the role of a scaling device accomplishing adaptation to the dynamic range. A writing-pad storage device and the register it includes are intended for the storage of constants and intermediate results, and also to assure interaction of the arithmetic-logic unit with the DA converter and the peripheral interface adapter. The latter can accomplish output of data of the the intelligent information form converter to peripherals or to the system bus of a computer of higher rank. From the design point of view the writing-pad storage device, shifter and arithmetic-logic unit can form a single whole. Such a structure is sufficiently universal and can be executed on the basis of microprocessor sets of large-scale integrated microcircuits of series K-587, 564RU2A, K537RU1, etc, and also the large-scale integrated microcircuits of K1801VE1. Structures have already appeared now which are similar to those presented on Figure 3, executed on a single chip [9].

An alternative structure is possible in which the role of the AD converter control unit is performed by a microprocessor [10] (Fig 4). Such an intell information form converter functions as follows. A number (generally an arbitrary one) is introduced into the arithmetic-logic unit of the microprocessor. Its code is transmitted through the peripheral interface adapter to the DA converter input, and after conversion the obtained analog signal is compared in a comparator with the input signal, and the result of the comparison is introduced into a microprocessor. After

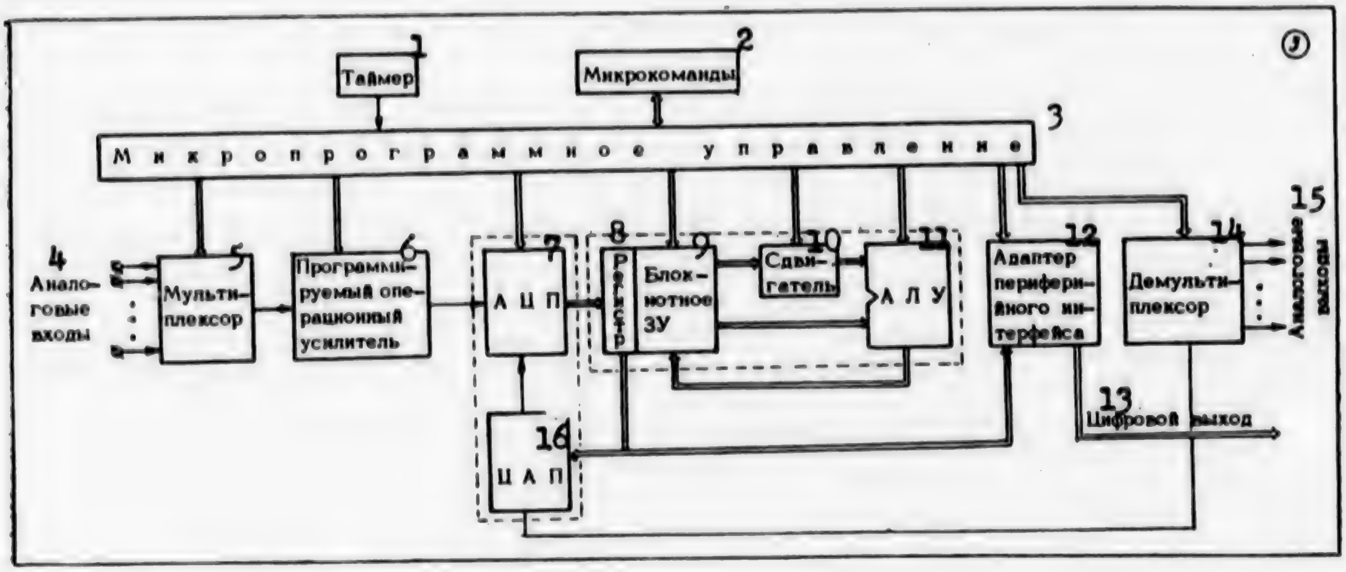


Figure 3.
Structure of a specialized intelligent information form converter.

1 -- Timer
2 -- Microinstructions
3 -- Microprogram control
4 -- Analog inputs
5 -- Multiplexer
6 -- Programmable operationsl amplifier
7 -- analog-digital converter
8 -- Register
9 -- Writing-pad memory
10 -- Shifter
11 -- Arithmetic-logic unit
12 -- Peripheral interface adapter
13 -- Digital output
14 -- Demultiplexer
15 -- Analog outputs
16 -- Digital-analog converter

some iterations the digital equivalent of the input signal is processed in the arithmetic-logic unit accumulator. The instruction to conclude the conversion initiates the start of operations in processing the digital value of the input signal of the intelligent information form converter. The described converter does not have great speed, but it is readily realizable by means of, for example, the single-chip "ELEKTRONIKA NTs-80" microcomputer and two additional units, a DA converter and a comparator.

Figure 5 presents a universal structure of an intelligent information form converter [3,8]. A channel of direct memory access is used here to increase the speed of the intelligent information form converter. This structure can be expanded functionally, for example, by connecting to the second subchannel a channel of direct memory access with a controller of a specialized processor of the BPF [not further identified] type or a display with supplementation of the structure by a second programmable input-output or connection of a keyboard panel, an input-output channel or a representation device, etc. An "ELEKTRONIKA NTs-8001" microcomputer can also be the basis for realization of the given structure.

If there are rigid requirements for reliability and failure resistance of intelligent information form converters, for example, when they are installed in autonomous

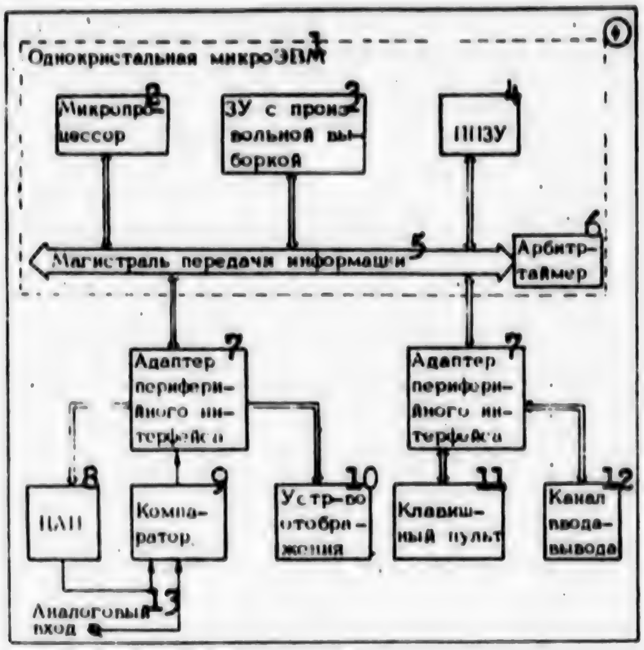


Figure 4. Structural diagram of an intelligent information form converter in which a microprocessor controls the work of the AD converter.

1 -- Single-chip microcomputer
2 -- Microprocessor
3 -- Memory with arbitrary selection
4 -- Semipermanent memory unit
5 -- Main line of information transmission
6 -- Arbitrator-timer
7 -- Peripheral interface adapter
8 -- Digital-analog converter
9 -- Comparator
10 -- Representation device
11 -- Keyboard panel
12 -- Input-output channel
13 -- Analog input

unserviceable complexes, such as a communications satellite, meteorological stations, etc, supplementary hardware and software which assures the creation of a varying structure must be used. To achieve the desired fail-safety, three types of redundancy can be introduced here: structural (of hardware), informational (of instructions and data) and procedural (of processing).

Structural redundancy can be of two types [11]. Redundancy of the first type is characterized by the fact that at each given moment only one of several modules of the same kind is functioning and the rest are excluded, that is, are in a "cold" reserve. This type of redundancy has low power consumption, but the time of transition from a failing module to one in reserve is rather large, as it includes a number of operations connected with commutation, establishment of the initial conditions, checking of the state, etc, and the rather complex monitoring system which makes the decision regarding transition to the module in reserve does not always take into account all the factors connected with random single malfunctions.

When there is redundancy of the second type, identical modules function simultaneously and analysis of the failures and degree of resistance to them is made on the basis of comparison of the results of work of each module in the given stage.

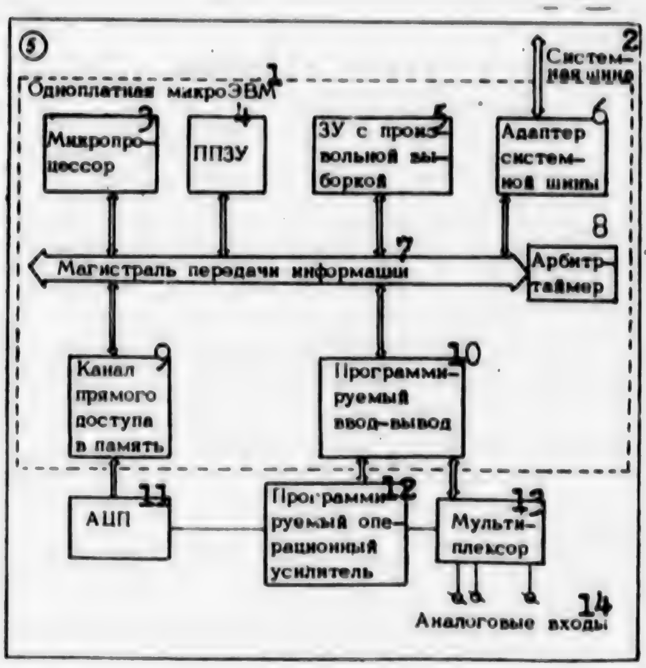


Figure 5. Structural diagram of a universal information form converter.

1 -- Single-chip microcomputer
2 -- System bus
3 -- Microprocessor
4 -- Semipermanent memory unit
5 -- Memory with arbitrary selection
6 -- System bus adapter
7 -- Main line of information transmission
8 -- Arbitrator-timer
9 -- Direct memory access channel
10 -- Programmable input-output
11 -- Analog-digital converter
12 -- Programmable operational amplifier
13 -- Multiplexor
14 -- Analog inputs

Informational redundancy is connected in general with the method of excess variables [12,13], when additional variables are introduced into the system, as well as relatively small additional software and hardware to obtain monitoring correlations which permit automatically detecting and correcting errors directly in the process of work of the system, that is, without halting it, commutation of modules, etc. A very simple form of informational redundancy is the introduction of check bits into each information word.

Procedural redundancy is connected with multiple repetition of each stage of information processing with the same raw data, analysis of the obtained results and deciding which result should be considered the most probable. Also unavoidable here is the introduction of structural redundancy: segments of memory for storing the results of successive reruns of a program or separate fragments of a program, and segments of memory for storing a program of analysis of the results of successive reruns and decision making.

In practice a combination of different methods of introduction and redundancy is usually used, and this assures adequate flexibility of intelligent information form converters and the required fail-safety and degree of reliability of the output data. As for the level on which it is rational to introduce structural redundancy, as spare modules it is best to use the structures presented on Figures 3-5, considered as a single whole. This is advisable, since in the near future single-chip structures of the same type or one close to it will become available.

Solution of the above-discussed tasks of optimum selection of a set of functions, hardware and software and also of structure is only the first step of a complex process, the final goal of which is the creation on the basis of intelligent information form converters of an "intelligent" computer channel or interface which permits very effectively combining into a single computing and data processing system various sources and receivers of information, and also means for its temporary storage, transmission, preliminary processing and representation independently of the form of representation, the signal parameters, format and methods of data access and exchange.

BIBLIOGRAPHY

1. Pike, G. E. "Development of software for minicomputers." In book: "Mini-EVM" [Minicomputers]. Moscow, 1975, pp 27-41.

2. Tirof, R. "Obrabotka dannykh v upravlenii" [Data Processing in Control]. Moscow, Mir, 1976. Vol 2, 534 pages.

3. Kondalev, A. I. "New Stage in Development of Information Form Converters." VISNYK AN URSR, 1980, No 7, pp 80-94.

4. Yeremeyev, I. S. "Ustroystva szhatii informatsii" [Information Compression Devices]. Moscow, Energiya, 1980, 160 pages.

5. Alipov, N. V. "On One Method of Increasing Interference Immunity of Devices for Primary Information Conversion." AVTOMATIKA I VYCHISLITEL'NAYA TEKHNIKA, 1980, No 6, pp 80-85.

6. Hemming, R. V. "Tsifrovye fil'try" [Digital Filters]. Moscow, Sovetskoye Radio, 1980, 224 pages.

7. Ling, H., and Palermo, F. P. "Block-oriented Information Compression." IBM JOURNAL OF RESEARCH AND DEVELOPMENT, 1975, Vol 10, No 2, pp 141-145.

8. Vasenkov, A. A. "Development of Microprocessors and Microcomputers of the 'ELEKTRONIKA NTs' Family on the Basis of Complexly System Programs." ELEKTRONNAYA PROMYSHLENNOST', 1979, No 11, pp 13-17.

9. "Single-chip Analog Microcomputer Processes Complex Signals in Real Time." COMPUTER DESIGN, 1979, Vol 18, No 10, pp 193-194.

10. "SC/MP as an Analogue-to-Digital Converter." ELECTRONIC ENGINEERING, 1978, Vol 50, No 604, pp 24-25.

11. Su, S. Y. H., and Du Casse, E. "A Hardware Redundancy Reconfiguration Scheme for Tolerating Multiple Module Failures." IEEE TRANSACTIONS ON COMPUTERS, 1980, Vol 29, No 3, pp 254-258.

12. Ignat'yev, M. B., and Mikhaylov, V. V. "Metod povysheniya funktsional'noy nadezhnosti i tochnosti vychislitel'nykh ustroystv" [Method of Increasing the Functional Reliability and Precision of Computers]. Leningrad, LDNTI, 1964, 35 pages.

13. Hamming, R. "Error Detecting and Error Correcting Codes." BELL SYSTEM TECHNICAL JOURNAL, 1950, Vol 29, pp 147-160.

2174
CSO: 1863/11

UDC 681.3.06.4

DISTINCTIVE FEATURES OF ARCHITECTURE AND STRUCTURE OF PROBLEM-ORIENTED BASIC COMPUTER FOR PROCESSING DATA OF FULL-SCALE TESTS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 4, Jul-Aug 81 (manuscript received 29 Jan 81, after revision 18 Feb 81) pp 64-68

[Article by Grigoriy Ivanovich Korniyenko, candidate of technical sciences, Special Design Office, Mathematical Machines Section, Institute of Cybernetics, UkSSR Academy of Sciences, Kiev]

[Text] Introduction. The hardware of systems for processing data obtained in full-scale tests includes:

--a basic computer with a set of series-produced peripherals, for example, a punched tape input-output device, video terminals, teletypes and magnetic disk and magnetic tape stores;

--equipment for communication with the object of the tests, for example, multichannel analog-digital converters, controllers of official telemetric systems, devices for output of control actions and registers of external interruptions;

--functional possibilities of the system at the necessary productivity. Tasks in processing experimental data are mainly determined by the parameters of the basic computer.

On the basis of a systems approach with consideration of the basic principles of construction of problem-oriented systems [1-3], in 1975-1980 a basic computer was developed for application in full-scale operating conditions. Below is described an approach to the creation of such a computer which takes into consideration both the specifics of algorithms for processing information from tests of complex objects and the requirements for adequate universality in solving a broad circle of scientific and technical tasks with the use of devices for communication with objects of control and non-standard graphic devices.

Interconnection of architecture and structure. A very critical stage in planning a basic computer is the development of the architecture. It is precisely in that stage that such functional possibilities of computers are determined as the formats of data processable by processors and a large number of operations on them, work in multiprocessor and multiprogram modes, the real scale and the time distribution, the dynamic distribution of memory and the increase in the number and types of peripherals. The efficiency of use of computers by the programmer depends to a considerable degree on the capacity of the means of his interaction with the computer. The only means of such interaction is the instructions list, in which the

architecture of the processor, memory and input-output subsystem is reflected in compressed form. The introduction of new components into the architecture usually leads to expansion of the instruction set.

The structure of the basic computer is the materialization of the architecture in hardware. In the development of the structure the latest circuitry solutions, the elementary base and the design execution of the computer are taken into consideration. The architecture and structure exert mutual influence on each other. Thus the use of virtual memory with page organization requires introduction into the processor structure of special registers of additions and logical circuits for recording the frequency of referral to pages of the memory. On the other hand, the application of dynamic microprogramming, when there is the possibility of the loading into the processor control memory of microprograms on the course of execution of the tasks, permits enriching the architecture of the processor by adding new machine instructions.

The requirement of program compatibility for universal computers with wide application (YeS and SM computers) had the result that they are improved only on the level of the structure, and the architecture remains as before. Characteristic in that case is increase in the quantity of hardware and, consequently, of cost. If for problem-oriented complexes for the conducting of full-scale tests requirements of program compatibility with other computers are not presented, then the possibility appears of introducing into the architecture functions specific for a given application. This permits obtaining a considerable gain in productivity in individual tasks at a complexity of the structure of the basic computer comparable with that of series-produced computers of the same class.

The Correlation of Hardware Expenditures. In analyzing the architecture and structure of the basic computer it is necessary to examine the general organization and interaction of the main units and the organization of processors, stores and the input-output subsystem. Known methods of minicomputer synthesis and analysis [4] deal mainly with processors and immediate-access memories. Questions of the development of the input-output subsystem, which includes the channels and their interfaces, peripheral controllers and the peripherals themselves, which form a considerable portion of all the hardware, have not been completely explained in the literature.

Quantitative indicators of expenditures on electronic equipment by separate components of two computing complexes are presented in the table. The first is the SM-1401 (SM-4) control computer complex of wide application in the basic configuration [5], and the second--a two-processor digital computing complex for work in full-scale conditions (the "Pirs" digital computing complex) [6]. It should be noted that when computing complexes are used in an expanded configuration, when the number of peripherals and their nomenclature increase, the share of input-output equipment increases still more in comparison with that shown in the table. Therefore, in optimizing the hardware of the basic computer, input-output devices should be given no less attention than devices of processors and memory.

General Organization of the Computer. In selecting the general organization of the basic computer, consideration was given to such very typical modes of operation as the processing of the flow of multichannel high-frequency information in real time by methods of mathematical statistics [7,8], the processing of graphic information

Components	SM-1401 Number of integrated microcircuits		"Pirs" DDC Number of integrated microcircuits	
	units	%	units	%
Processor	699	22.3	800	22.7
Memory devices (volume 64K bytes)	1282	40.9	1496	42.4
Input-output devices: controllers, interface units and peripherals themselves (for the SM-1401: SPTP SM-6202, CTA-2000, DARO, magnetic disk store SM-5402; for the "Pirs" DDC: FS-1501, PL-150, magnetic disk store YeS5060, built-in video terminal, EKhB graph plotter, equipment for communication with the object of tests	1152	36.8	1229	34.9
Total	3133	100.0	3525	100.0

which can be reproduced on raster displays [9] and multiprogramming and the maintenance of disk files [10]. Reliability of functioning under rigorous operating conditions was an additional requirement for computers.

Multiprocessor organization of the basic computer has proven to be very suitable [6]. In it the processors work on the total field of the immediate-access memory and can be either completely identical or have a different specialization. Thus, in the "Pirs" digital computing complex the second processor is oriented toward work with graphic information for various television devices. The orientation is executed both on the level of the architecture of the processor through the introduction of additional instrruction as well as on the level of the structure through the introduction of control units by television equipment using a common immediate-access memory with the processor. Three identical processors were used in some special applications. At the same time, it is possible to use the configuration of the basic computer with a single processor. Thus, for relatively uncomplicated instrumentation systems developed for the USSR Gosstandart, a single-processor variant of the basic computer, the "Etalon," series-produced, was used.

The problem of assuring a carrying capacity of the immediate-access memory channel sufficient for the simultaneous access of several processors to it without conflict has proven to be a very complex technical problem in realizing the structure of a multiprocessor computer. That problem was solved by sectioning the immediate-access memory and introducing stratification. The maximum number of processors of the basic computer with consideration of technical limitations is assumed to be 3. The work of the processors is synchronized by a real-time operating system which uses peripheral interruption equipment [12].

The requirement of reliability was caused by a special design execution of the basic computer, thanks to which it withstands considerable vibrations and shocks and also can be mounted on the test object made of individual structural units in 25-30 minutes. To increase reliability, resistance of the computer to network power failures also is provided.

The Processor. A procedure described in [4] was used to select the architecture and structure of the basic computer processor. The raw data were the parameters of algorithms and programs obtained by analyzing the common properties of the most typical modes of operation [7,8] and machine instruction libraries from which various instruction sets of minicomputers can be constructed. Additionally taken into consideration are both experience in the development of an entire series of problem-oriented computers and the experience of domestic industry in series-producing computer hardware. Analysis of the latest foreign minicomputers, especially Data General's "Eclipse," also has proven to be an important aid.

As a result a 16-bit processor with 16 general purpose registers was synthesized, one operating with data presented in formats with a fixed point (with a length of 16 and 32 bits) and with a floating point, which have a 24-bit mantissa and a half-bit order. It was taken into account in that case that the basic processing must be done in a mode with a floating point.

The nomenclature of processor instructions can be provisionally divided into three groups:

--borrowing from a recommended instruction library [4] and from the instruction set of the preceding computer series;

--synthesized in accordance with the problem orientation of the computer toward the class of problems;

--unique for each specific application of the basic computer.

Instructions of the second group can be obtained with use of the method described in [13]. To do that, statistical information is determined on fragments of algorithms for processing and mechanisms of a multiprogram operating system, mechanisms critical toward the time of their execution, then machine instructions of the type of compositions and combinations are established. Thus the instruction set includes the following operations:

--reading and recording of a byte according to its relative number in a line of text;

--reading and recording of a bit according to its relative position in a line of bits;

--separation of the bit subline from a line of bits;

--conversion of types of data from one internal representation to another;

--separation of the whole part of the number represented in a format with a floating point;

--sorting of data by various characteristics;

--determination of the number of the priority unit in a line of bits;

--conversion of a number into a positional binary code;

--checking of the code for evenness;

--capture of a dynamic segment of the necessary size;

--liberation of a dynamic segment;

--entry into the procedure of processing interruption of the corresponding class with preservation of the state of the processor registers;

--departure from the procedure of processing interruption with restoration of the processor registers;

--preservation of registers in the area of preservation of the task;

--restoration of registers from the area of preservation of the task;

--referral to an operational system;

--switching of tasks in a multiprogram mode with their priorities taken into consideration;

--activation of system tasks with respect to interruptions and system calls.

The method of microprogram control was used to accomplish such an instruction set. Practice has shown that the application of problem-oriented instructions of the second group permits reducing the total time of readoff of real-time tasks by a factor of 3-8 in comparison with the application of instructions of only the first group. The microprograms of instructions of the first and second groups are arranged in a permanent control store.

Instructions of the third group are accomplished by means of dynamic microprogramming. Their microprograms were originally placed in the body of the loading module of the task in the form of a set of binary constants, then they were transferred to the processor immediate-access store dynamically according to the course of execution of the program by means of special system calls. This permits the user to program on the microprogram level and use all possibilities of the processor hardware.

The Memory. Without dwelling on the distinctive features of memory units characteristic of microcomputers we will distinguish only the specific ones flowing from the conditions of the given class of applications.

To increase the degree of readiness of computers for operation and convenience of the operator's work during interaction with both disk and diskless operating systems, there is wide use of permanent memories (postoyannoye zapominayushcheye ustroystvo--PZU) of the instruction level, which contain programs of the operating system, translators and the principal processing programs.

The memory architecture is such that the immediate-access memory (operativnoye zapominayushcheye ustroystvo--OZU) and the PZU form a single address space with a total volume of 64K 16-bit positions. The OZU units are disposed at the start and the PZU units at the end of the address space. Increase of the OZU volume proceeds in the direction of increase of addresses and of the PZU volume in the direction of their reduction. In the writing of a program, where it will be subsequently placed, in the OZU or the PZU, is usually taken into consideration. Thus, if a program will be placed in the PZU, working cells should not be reserved in the region of the program, as recording there will be impossible.

To overcome this shortcoming an original mechanism of dynamic memory distribution has been introduced [14,15], the essence of which is that at the program unit input a memory of the necessary size for local variables is set aside for it. At the program unit output that region of the memory is freed. Separation of the regions of instructions and data permits not only simply transferring program units from

OZU to the PZU but also saving the OZU volume necessary for running the task. This is possible thanks to covering of the dynamic segments of program units of a single level. As has been shown by the results of the operation of program complexes using a dynamic memory, the volume of necessary memory for data is reduced by one fifth, and in isolated cases of 2/3 - 3/4 as compared with the generally accepted statistical memory distribution.

Another important advantage of the dynamic memory distribution is the fact that all programs automatically are re-enterable, which is very urgent in multiprogram work and also leads to an economy of memory.

The presence of a dynamic distribution mechanism in the memory architecture made it necessary to introduce two special machine instructions relating to the second group. In the processor structure that mechanism is realized by the addition of only one dynamic segment register, that is, a considerable enrichment of the architecture of the basic computer did not lead in practice to complication of its structure.

The Input-Output Subsystem. In the development of input-output hardware the following interconnected tasks are solved: channel organization, interface selection, interruption system organization, construction of standard memory controllers, connection of various devices for connection with the object of the tests and connection of nonstandard graphic devices [16].

Since in the basic computer requirements of compatibility (either program or on the level of the channel interfaces) with any sort of computer were not presented, the input-output subsystem was synthesized in accordance with the requirements of problem orientation. In addition, an analysis was made of the information exchange channels of the domestic series-produced SM-2 and SM-4 minicomputers, Digital Equipment's PDP-8, Data General's Nova, etc.

The analysis showed that in the basic computer it is advisable to have two different channels--program-controllable and of direct memory access.

The first channel has a main-line interface and permits the connection of up to 256 peripherals capable of functioning in a start-stop mode with information exchange by bytes. The transmission of each byte of information is accompanied by a signal of interruption from the program-controllable channel. The interface of that channel is selected with consideration of the need for connection to it of new peripherals with minimum expenditures of electronic equipment and the provision of a simple logic of servicing peripherals by programs--drivers of the operating system.

For the channel of direct memory access the requirement was presented of assuring a total carrying capacity of at least 700 words/s during simultaneous data exchange with several high-speed peripherals (magnetic disk stores and magnetic registers of various types). Up to 16 group rapid periphery controllers working in conditions of transmission of blocks of information can be connected to the main-line interface of that channel. Completion of exchange of a block causes interruption of the current program from the channel.

Channels of the basic computer have functional completeness for the organization of input-output operations with standard peripherals. A distinctive feature of the

direct memory access channel is an original method of continuous input of high-frequency information from the equipment for communication with the object of the tests and various telemetric magnetic tape units [17].

The task of assuring input of a continuous flow of data in the course of a long time without losses arises in all instrumentation systems. When series-produced universal minicomputers are used, information losses already occur at an exchange rate of 5-10 words/s. The use in the basic computter of special software and hardware of the direct memory access channel, based on an algorithm for binary buffering of the input, permitted assuring the input without losses from complex data sources which cannot work in a start-stop mode.

The interruption system is multilevel with priorities. In the origination of an interruption the processor executes a procedure for entry into the state of interruption, interruption signals of lower priority than that of the interruption being processed are masked, and in the region of preservation of the task the values of the processor registers are preserved. In series-produced computers the enumerated functions are usually performed solely through programs. The use of an expanded procedure for executing interruptions in the basic computer reduced the time of reaction to interruption to 18 microseconds, and that opened up prospects of using a basic computer in complex real-time systems.

Conclusion. Realization of the described approach to the development of hardware of the basic computer became possible thanks to the simultaneous development of software systems for processing experimental data in real time and the hardware for such processing. In that case a solution was obtained for the problem of assuring an optimum correlation between the hardware and software, which assured high quantitative and qualitative indicators of the productivity of the basic computer for the class of problems.

BIBLIOGRAPHY

1. Glushkov, V. M. "Vvedeniye v ASU" [Introduction to Automated Control Systems]. Kiev, Tekhnika, 1972, 310 pages.

2. Malinovskiy, B. N., Yanovich, I. A., Yegipko, V. M., et al. "Osnovy proyektirovaniya upravlyayushikh mashin promyshlennogo naznacheniya" [Principles of Planning Control Machines for Industry]. Moscow, Mashinostroyeniye, 1969, 343 pages.

3. Barsuk, Ya. I., Korinenko, G. I., Sergiyenko, I. V., and Tesler, G. S. "On Problem Orientation of Minicomputers." USiM, 1973, No 6, pp 45-59.

4. Malinovskiy, B. N., Yakovlev, Yu. S., and Mikovenko, Ye. T. "Analiz i sintez mini-EVM" [Analysis and Synthesis of Minicomputers]. Kiev, Naukova dumka, 1976, 174 pages.

5. Dedov, Z. A., Ostrovskiy, M. A., Piselev, K. V., et al. "Malyye EVM i ikh primeneniye" [Small Computers and Their Application]. Moscow, Statistika, 1980, 340 pages.

6. Korniyenko, G. I. "Digital Computing Complex for Multichannel Processing of Experimental Data in Real Time (TsVK 'Pirs')." USiM, 1979, No 6, pp 130-136.

7. Korniyenko, G. I., Dianov, M. I., and Dianov, V. I. "Principles of Construction of Digital Multichannel Approximate Analyzers." KIBERNETIKA, 1980, No 6, pp 63-67.

8. Korniyenko, G. I., Dianov, V. I., and Dianov, M. I. "Digital Analysis of Signals in Experimental Data Processing Systems." USiM, 1980, No 6, pp 100-104.

9. Korniyenko, G. I., Dianov, M. I., and Dianov, V. I. "Organization of the Process of Visualizing Results of Full-scale Test Data Processing Systems." USiM, 1981, No 1, pp 108-112.

10. Korniyenko, G. I., and Sheverda, O. N. "Control of Resources in Full-scale Test Data Processing Systems." KIBERNETIKA, 1978, No 5, pp 41-45.

11. Korniyenko, G. I. "Problem-oriented Digital Computer 'Etalon' For Real-time Systems." USiM, 1979, No 1, pp 104-106.

12. Korniyenko, G. I. "Organization of Information Processing in Conditions of Approximate Analysis During Tests of Complex Technical Systems." In book: "Proyektirovaniye i vnedreniye novykh sredstv vychislitel'noy tekhniki" [Planning and Introduction of New Computer Hardware]. Kiev, Institute of Cybernetics, UkSSR Academy of Sciences, 1978, pp 11-17.

13. Simonyan, A. A. "On the Question of Increasing the Efficiency of a Computer Instruction Set." TSIFROVAYA VYCHISLITEL'NAYA TEKHNIKA I PROGRAMMIROVANIYE, 1969, No 5, pp 19-27.

14. Dianov, V. I. "On the Question of the Effective Use of Minicomputer Memory." USiM, 1978, No 5, pp 23-25.

15. Korniyenko, G. I., Dianov, V. I., and Dianov, M. I. "Method of Controlling the Memory of Data for Computers With a Limited Volume of Immediate-access Memory." USiM, 1980, No 4, pp 29-31.

16. Belyayev, A. K., Korniyenko, G. I., and Mudla, B. G. "On One Approach to Leading Information Out on a CRT in a Problem-oriented Minicomputer." In book: "Sredstva dialoga pri reshenii inzhenernykh zadach" [Means of Interaction in Solving Engineering Problems]. Kiev, 1974, p 29.

17. Korniyenko, G. I., Dianov, M. I., and Dianov, V. I. "Method of Organizing Continuous Input in Real-time Systems Based on Minicomputers." KIBERNETIKA, 1980, No 4, pp 122-125.

2174
CSO: 1863/11

UDC 681.032

SYNTHESIS OF CONTROL DEVICES WITH VARIABLE TIME DIAGRAMS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 4, Jul-Aug 81 (manuscript received 22 Apr 80, after revision 22 Feb 81) pp 68-76

[Article by Vyacheslav Mikhaylovich Ordyntsev, cand. of tech. sciences, Zhukovskiy]

[Text] A method is proposed for the construction of devices for the control of automation systems having several modes of operation which are characterized by time diagrams for issuance of control signals. The structure of the control device is based on the application of two types of special flip-flops on which the signals setting the required mode of operation of those devices act.

In the development of automation systems a need often arises for the creation of control devices which permit re-adjustment for the purpose of adaptation to changing conditions.

Control devices are known which adapt to the actual length of the process of measurement [1], the working frequency of the receiver of information [2] and the procedure for issuance of channel numbers in an address mode of measurements in information measurement systems [3].

In [4] a control device was proposed with a variable periodic time diagram intended for the generation of signals to control the hardware of large-scale multichannel automation systems with many analog-digital converters working simultaneously. A distinctive feature of this control device is two special flip-flops: an insert flip-flop [trigger-vstavka--TV] and an inverting flip-flop [trigger-invertor--TI], actions on which change the time diagram. The use of TV's and TI's simplifies the control device structure, facilitates the transition from one mode to another and opens up wide possibilities for the synthesis of control devices with a variable time diagram, some of which are examined below.

TV's and TI's are intended for use in binary pulse counters as one of the stages. The TV permits doubling the number of states of the binary counter. Increase in the number of states is achieved by introducing the TV into the binary counter, and reduction by excluding it. Thus it is possible to vary the order and period of issuance of control signals from the control device.

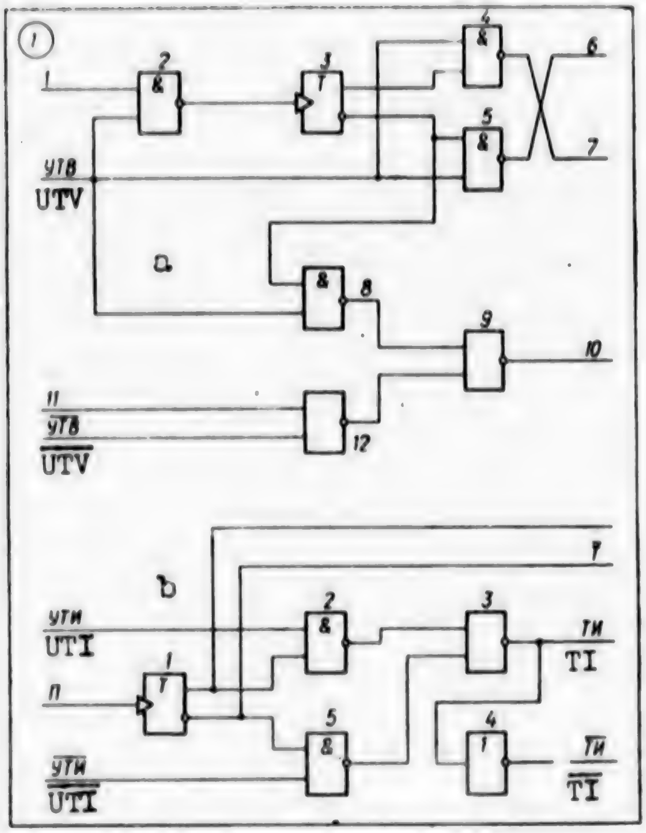


Figure 1. Diagrams of special flip-flops

a -- insert flip-flop (TV)
b -- inverting flip-flop (TI)

One possible variant of the schematic diagram of a TV is shown by Figure 1a.

TV control [upravleniye TV--UTV] is accomplished by the corresponding signal. If that signal is equal to "1" the TV works as an ordinary flip-flop. Transfer signal 1 from the preceding position of the binary counter arrives through AND-NOT element 2 on the flip-flop 3. Signals from the sides of the flip-flop, passing through AND-NOT elements 4 and 5, become the output TV signals 6 and 7. The signal from the "zero" side of flip-flop 3 passes through AND-NOT elements 8 and 9 and is converted into transfer signal 10 on the following discharge of the binary counter.

The control signal ⌉UTV is equal to the negative signal UTV. Therefore when the signal UTV is eaual to "1" the signal ⌉UTV is equal to "0" and signal 11 from the "zero" arm of the flip-flop of the preceding position cannot pass through AND-NOT element 12.

Transition of the signal UTV into the "0" state excludes TV from the counter. In that case AND-NOT elements 2, 4, 5 and 8 do not pass the input signals. Signals 6 and 7 prove to be fixed at the value "1". Signal ⌉UTV is equal to "1" and signal 11, in passing through AND-NOT elements 12 and 9, is converted into transfer signal 10.

Thus each TV can be in three states, depending on the UTV and the state of flip-flop 3. Those states are shown in Table 1.

Table 1

UTV	State: Flip-flop 3	TV
0	0	excluded
	1	
1	0	0
	1	1

Table 2

UTI	State: Flip-flop 1	TI
0	0	1
	1	0
1	0	0
	1	1

The TI differs from an ordinary flip-flop in the presence of a special circuit which under the effect of control signals UTI and $\neg$UTI can invert signals taken from the flip-flop sides. The TI makes it possible to change the order of control pulses in an invariable period of issuance. A schematic diagram of TI is shown by Figure 1b. On the counter input P of flip-flop 1 the transfer signal arrives from the preceding position of the binary counter. Signals T and $\neg$T are issued from the "1" and "0" arms of flip-flop 1 and are not a function of UTI and $\neg$UTI.

If UTI = 1 and ($\neg$UTI = 0), then AND-NOT element 2 passes signal T which, passing through AND-NOT elements 3 and 4, generate signals TI and $\neg$TI, where TI = T and $\neg$TI = $\neg$T. AND-NOT element 5 does not pass signal $\neg$T. But if UTI = 0 ($\neg$UTI = 1), element 2 does not pass signal T but element 5 passes signal $\neg$T, which proceeds through elements 3 and 4, generating signals $\neg$TI and TI. Now TI = $\neg$T and $\neg$TI = T.

Then flip-flop Ti can be in two states, depending of the value of UTI and the state of flip-flop 1. Those states are presented in Table 2.

A control device based on use of TV and TI consists of a modulo-N binary counter which includes two flip-flops. The outputs of the counter flip-flops are fed to the inputs of the decoder, the output signals of which are the control signals of the control device.

Let a certain control signal of the control device arise in the counter state H_p. Correspondence can readily be established between states H_p and H_e if N is known and the position number j $< j < N - 1$) in which TV is used? For example, H_p = = 100101 at N = 6 and j = 3; then we obtain H_e = 10001 at UTV = 0, if we exclude the j-th position from H_p.

A method of representation based on analysis of the Graphs of Work and Possible Switchings [Graf Raboty i Vozmozhnykh Pereklyucheniy--GRVP] is more convenient.

Two GRVP's for a control device at N = 4 are shown on Figures 2 and 3. The small circles with numbers designate states of the binary counter of control signals, that is, the combinations of states of the flip-flops with counter inputs, including flip-flop 3, shown on Figure 1a, if in the counter there are TV's, and flip-flop 1, shown on Figure 1b, if there are TI's.

Shown on Figure 2 is a GRVP for a control device in which there is one TV at UTV = 0. The states of the control signal counter at UTV = 1 are shown in the form of small

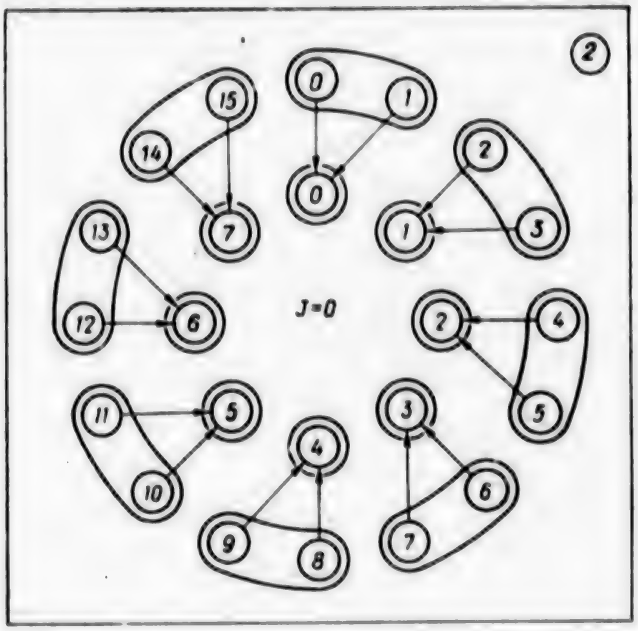


Figure 2. Graph of work and possible switching showing change of the time diagram of a control device with one TV at $N = 4$, $j = 0$.

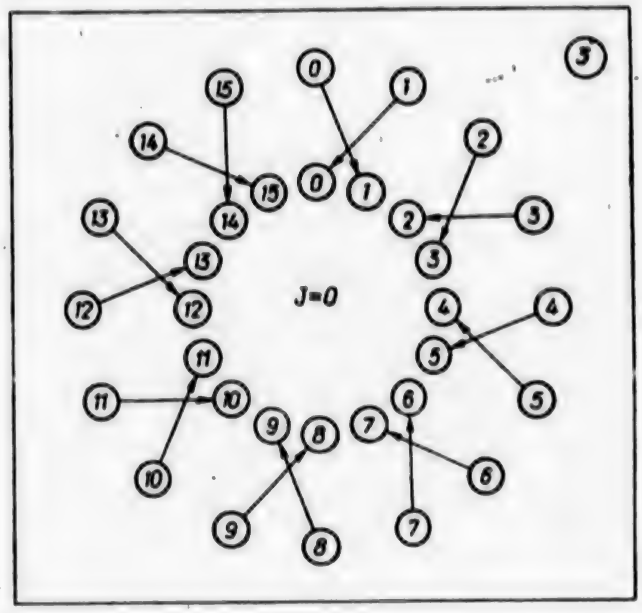


Figure 3. Graph of work and possible switching showing change of the time diagram of a control device with one TI at $N = 4$, $j = 0$.

circles on the circumference with the large radius. The states at UTV = 0 correspond to the eight small circles on the smaller circumference. During functioning of the signal device the states replace one another in the order of increase of their numbers. Transitions during change of the UTV from "1" to "0" are designated by arrows.

It is evident that each graph is divided into several isolated subgraphs connecting the corresponding states H_p and H_e. If we designate the number of states H_p by N_p and the number of states H_e by N_e, we obtain $N_p = 2N_e$.

We will call states H_p parts and states H_e combinations. The arrows show the transitions of parts into combinations. For a control device with one TV two parts are connected with one combination.

N variants of transition during change of UTV from 0 to 1 can be realized as a function of j. For example, for the state $H_e = 3$ the following transitions into state H_p are possible: 6 and 7, 5 and 7, 3 and 7 and 3 and 11, at j values of 0, 1, 2 and 3 respectively.

If during change of the mode of operations the number of positions of the counter must not change, then several TV's can be used simultaneously. The transition from any mode to any other can be accomplished directly by excluding some TV's and including others.

Shown on Figure 3 is a GRVP illustrating the changes of the time diagram of a central device in which TI was used instead of one of the positional flip-flops. Here during variation of the UTI signal a mutual interchange of states occurs. For example, the state $H_e = 0$ changes into the state $H_p = 1$ and the state $H_e = 1$ into the state $H_p = 0$.

Let a certain control signal originate at the state H_e of a control device counter, in the j-th position of which stands TI, and UTI = 1, then the code of the state H_p corresponding to issuance of the same signal at UTI = 0 can be found by inverting the j-th position of the code of state H_e. For example, if H_e = 101101 at N = 6 and J = 3, then H_p = 100101.

A common feature of GRVP's is central symmetry. This property is especially useful in the construction of control devices of multichannel information-measuring systems in which it is necessary to identically vary the time diagrams for issuance of control signals in all channels working in parallel but with phase shift.

On the basis of analysis of GRVP's it is necessary to select from among the possible switchings the necessary ones which connect active states of control devices in different modes of their operation.

We will call active those states of control devices in which control signals are issued. We will designate control signals by $C0_\omega$, $C1_\omega$, ..., CQ_ω, ..., $C(S-1)_\omega$, CS_ω, the active states by $H_{0\omega}$, $H_{1\omega}$, ..., $H_{8\omega}$, ..., $H_{s\omega}$ and the intervals of time between moments of onset of active states by $\tau_{1\omega}$, $\tau_{q\omega}$, ..., $\tau_{(s-1)\omega}$, $\tau_{s\omega}$. In that case the interval $\tau_{q\omega}$ precedes the state $H_{q\omega}$. The subscript ω serves to designate the control device mode of operation and $s = q_{max}$.

It must be borne in mind that, during change of the control device mode of operation, the order of issuance of control signals can vary, and so the ordinal numbers and active states in general cannot coincide.

Active states have a successively increasing numeration and at $H_{1\omega} = 0$ are determined by the following expression:

$$H_{q\omega} = \sum_{i=1}^{q} \text{integer}\left(\frac{\tau_{i\omega}}{T}\right). \qquad (1)$$

where T is the period of pulse following.

The total number U_ω of control device states in mode ω is queal to

$$U_\omega = 1 + H_{s\omega} = 1 + \sum_{i=1}^{i=q_{max}} \text{integer}\left(\frac{\tau_{i\omega}}{T}\right). \qquad (2)$$

For simplicity we will assume that

$$U_\omega = 2^{K_\omega}.$$

where t_ω is the number of counter positions in mode ω. It is obvious that g_ω is a whole number. Then

$$g_\omega = \log_2 U_\omega . \qquad (3)$$

Ww will use the subscript e to designate one mode and p the other. Then by using (1), (2) and (3) it can be determined that

$$g_e = \log_2 U_e, \quad g_p = \log_2 U_p. \qquad (4)$$

The obtained data permit determining the number n_{TV} of TV's in the control device. For $g_p \geqslant g_e$

$$n_{TB} = g_p - g_e. \qquad (5)$$

If $n_{TV} = 0$, TV is not required.

To determine the positions occupied by TV and TI in the control device counter it is necessary to compile an active states matrix [matritsa aktivnykh sostoyaniya--MAS] for each of the control device modes. For that purpose a Graph of Work and Switchings [Graf Raboty i Pereklyucheniy--GRP] must be constructed. The GRP is executed in the form of concentric circles, each of which corresponds to one of the control device modes of operation. On each of the circles are 2^{q_ω} circles designating possible control device states in the given mode. Decimal numbers corresponding to the possible control device states in that mode are written in the circles. Beside the active states, the names of the control signals issued in those states are recorded. Movement along each of the rings in the direction of increase of the states describes the work of the control device in a certain mode.

If we connect with arrows the active states in which control signals of the same kind are issued in different modes, we obtain the GRP.

To fill an active state matrix (MAS) it is necessary to take as a basis one of the control device modes and copy in a column the active states binary codes. The obtained table, in which the lines will correspond to the active states and the columns to the positions of the control device counter, will be the MAS of the given mode. To fill the MAS of another mode it is necessary, using the GRP, to write in a column the binary codes of the active states so that the control signals during movement along the columns alternates as in the preceding MAS. Two MAS's were obtained in that manner: $\|M_p\|$, having the dimensions $(s \times g_p)$, and $\|M_e\|$, having the dimensions $(s \times g_e)$. The positions of TV and TI must be determined by simultaneous analysis of $\|M_p\|$ and $\|M_e\|$.

The following must be borne in mind in that case. The subscripts of the matrix, it is assumed, increase from left to right and from the top down, and the binary code position numbers for the same reason increase from right to left.

To determine the positions occupied by TV's it is necessary to find columns absent in $\|M_e\|$. We will designate the $\|M_p\|$ columns by $\|P_j\|$, where $j = 1 - g_p$, and the $\|M_e\|$ columns by $\|E_k\|$, where $k = 1 - g_e$. Generally each $\|E_k\|$ column must be compared with $(g_p - g_e + 1)$ $\|P_j\|$ columns. In that case $k \leqslant j \leqslant (g_p - g_e + k)$. Thus it is necessary to execute n_{0s} operations of comparison:

$$n_{oc} = g_e(g_p - g_e + 1).$$

However, the number of comparisons of the $\|E_k\|$ column can be reduced if one takes into consideration the number of r_{k-1} columns with which $\|E_{k-1}\|$ coincided. Then for $\|E_k\|$ it is necessary to execute $g_p - g_e + k - r_{k-1}$ comparisons with $\|P_j\|$ columns at

$$(r_{\kappa-1} + 1) < j < (g_p - g_e + \kappa).$$

In that case the total number of operations of comparison is equal to

$$n^*_{oc} = \sum_{\kappa=1}^{\kappa=g_e} (g_p - g_e + \kappa - r_{\kappa-1}) =$$

$$= g_e(g_p - g_e) + \sum_{\kappa=1}^{\kappa=g_e} (\kappa - r_{\kappa-1}).$$

Since $r_{k-1} \geqslant k$, then $n^*_{0s} \leqslant n_{0s}$.

The operation of comparison of $\|P_j\|$ with $\|E_k\|$ is determined with the following expression which is originally executed at $j = k = 0$:

$$\|1_i\|(\|P_j\| - \|Э_\kappa\|) = \begin{cases} = 0 \\ \neq 0, \ j < (g_p - g_e + k), \\ \neq 0, \ j = (g_p - g_e + k), \end{cases} \quad (6)$$

where $\|1_i\|$ is a matrix-line consisting of units and having the dimensions 1 x s.

In the first case the compared columns coincided, and this means neither TV nor TI can be the binary counter, the number of which corresponds to $\|P_j\|$. Then the value of j is remembered and a verification made of the inequality:

$$\kappa < g_e. \quad (7)$$

When the result is positive the value of k is increased by unity

$$\kappa = \kappa + 1, \quad (8)$$

where the new value of k is written on the left side of the equal sign, and the old value on the right. This principle of recording is also used later on.

The value of j is increased by unity

$$j = j + 1. \quad (9)$$

and operation (6) is repeated.

In the second case operation (6) is repeated at the old value of k and the new value of j, determined with expression (9).

In the third case the number is $\|E_k\|$, that is, k corresponds to the position of the binary counter in which the TI must be situated. That value of k is remembered. A verification is made of the inequality

$$\kappa < g_e.$$

When the result is positive a new value of k is calculated with (8). The initial number $\|P_j\|$ is determined:

$$j - r_{n\ 1} = g_p - g_e + \kappa,$$

and operation (8) is repeated. If in verifying (7) it turned out that $k = g_e$, that means the end of operations of comparison (6).

If we exclude from the set J containing all the whole numbers from 0 to g_e the values of j remembered in the execution of operations of comparison (6), we obtain the ordered set J*, consisting of n_a elements J_a arranged in the order of increase at $1 \leqslant a \leqslant n_a$:

$$n_a = n_{TИ} + n_{TB},$$

where n_{TI} and n_{TV} are the TI and TV numbers respectively.

The remembered values of k form the ordered set K*, consisting of n_a elements K_a arranged in order of increase at $1 \leqslant B \leqslant n_B$:

$$n_B = n_{TИ}.$$

The elements J_a is the number of $\|P_j\|$ columns corresponding to positions of TI or TV, the precise placement of which has not yet been established.

The elements K_B are subscripts of $\|E_k\|$ corresponding to TI positions in the control device binary counter when TV's are excluded.

It is obvious that $n_B - n_a = n_{TV}$.

A series of operations of comparison is further made of $\|P_j\|$ and $\|E_k\|$, the subscripts of which enter J* and K* respectively, in order to determine the pairs of columns in which the largest number of lines coincides.

For each value of K_B and all values of J_a satisfying the condition $b \leqslant a \leqslant [n_a - n_B) + B]$ is executed the operation

$$R_{aB} = \| 1_i \| \, | \, \| P_{J_a} \| - \| Э_{K_B} \| \, |. \qquad (10)$$

where $|\|A\||$ is the designation of the matrix in which all elements are equal to the model of elements of the matrix $\|A\|$, and $\|1_1\|$ is the matrix-line consisting of units and having the dimensions (1 x s).

The result of (10) is the matrix $\|R\|$ having the dimensions (n_a x n_B):

(see next page)

$$
\|R\| = \left\| \begin{array}{ccccc}
R_{11} & 0 & 0 & 0 & 0 \\
R_{21} & R_{22} & 0 & 0 & 0 \\
R_{31} & R_{32} & R_{33} & 0 & 0 \\
\cdots & \cdots & \cdots & \cdots & \cdots \\
\cdots & \cdots & \cdots & R_{(n_B-1)(n_B-1)} & 0 \\
\cdots & \cdots & \cdots & R_{n_B(n_B-1)} & R_{n_B n_B} \\
\cdots & \cdots & \cdots & \cdots & \cdots \\
R_{[(n_a-n_B)+1]1} & R_{[(n_a-n_B)+1]2} & \cdots & \cdots & \cdots \\
0 & R_{[(n_a-n_B)+2]2} & \cdots & \cdots & \cdots \\
0 & 0 & \cdots & \cdots & \cdots \\
\cdots & \cdots & \cdots & \cdots & \cdots \\
0 & \cdots & \cdots & R_{(n_a-1)(n_B-1)} & R_{(n_a-1)n_B} \\
0 & 0 & 0 & 0 & R_{n_a n_B}
\end{array} \right\| \qquad (11)
$$

The positive whole number R_{aB} is a measure ofthe coincidence of $\|P_a\|$ with $\|E_B\|$. It is equal to the number of active states in the formation of which TI participation is necessary.

The TI's in the counter must be arranged in relation to one another in the same manner as the $\|E_B\|$ columns in the matrix $\|M_p\|$. Therefore the processing of the matrix $\|R\|$ consists in searching for the minimal sum

$$S_{min} = R_{(c1)1} + R_{(c2)2} + \cdots + R_{(cn_B)n_B} \qquad (12)$$

at

$$cl > c(l-1). \qquad (13)$$

Condition (13) means that each successive term of the sum (12) must be lower and to the right of the preceding one in matrix (11).

When S_{min} has been determined, the values of the subscripts c1, c2, ..., cn_B determine the columns $\|P_a\|$ corresponding to the binary counter positions in which TI must be situated, and the remaining columns $\|P_B\|$ determine the TV position.

Let us examine the above-described procedure on the example of synthesis of a control device executed for a real information-measuring system with eight AD converters working in parallel [4,5]. Sensors must be added to the inputs of the AD converters in that system, either by contactless electronic commutators, in the commutating elements of which field transistors have been applied, or by commutators constructed on sealed-contact reed relays. Therefore one mode of operation of a control device is obliged to assure the use of electronic contactless commutators, and the other, of relay commutators. The control device issues five control signals: A, B, C, D and E, in each of eight channels. Table 3 shows the values of those signals and the time intervals between them. Taken as the unit of time measurement was the period T of tracking of pulses arriving at the input of the control device binary device binary counter. As is evident from the table, the mode of operation with relay commutators is characterixed by increase of the time interval between issuance of signals A and B. That time is required for the completion of transient processes in the sealed-contact reed relays, which are far longer than in commutating elements of electronic commutators.

Table 3

Control signal	Purpose of signal	Time interval between leading edges of control signals: electronic signals	relay signals
A	Advance of commutator to next position		
		2T	2T
B	Start of AD converter		
		27T	27T
C	Resetting of register receiving result of measurement		
		T	T
D	Transfer of code of result of measurement from AD converter to register		
		T	T
E	Advance of counter generating binary codes of pickup addresses		
		T	T
A	Advance of commutator		
	Control signal issuance cycle length	32T	64T

It must be noted that one cannot, by simply introducing delay between the moments of issuance of signals A and B, optimally solve the task, as the time diagrams for issuance of control signals are laid one upon the other in different channels, and therefore a delay useful in one channel is "parasitic" in the remaining seven.

As a result the length of a cycle increases to 288T and the speed of the system drops substantially. The use of control devices with TI and TV examined in the present example permitted increasing the speed of the system 4.5-fold on account of complete elimination of "parasitic" delay.

Synthesis of the given control device starts with construction of a Graph of Work and Switchings, which is presented on Figure 4. At first on the basis of the data of Table 3 on the circles of the large and small radius active states are arranged, beside which the designations of the control signals are written: A0, B0, C0, D0, E0, A1, B1, ..., C7, D7 (the numbers designate the AD converter number). In the given case $s = q_{max} = 40$. This makes it possible to determine the values of $\tau_{1\omega}$ which are presented in Table 4.

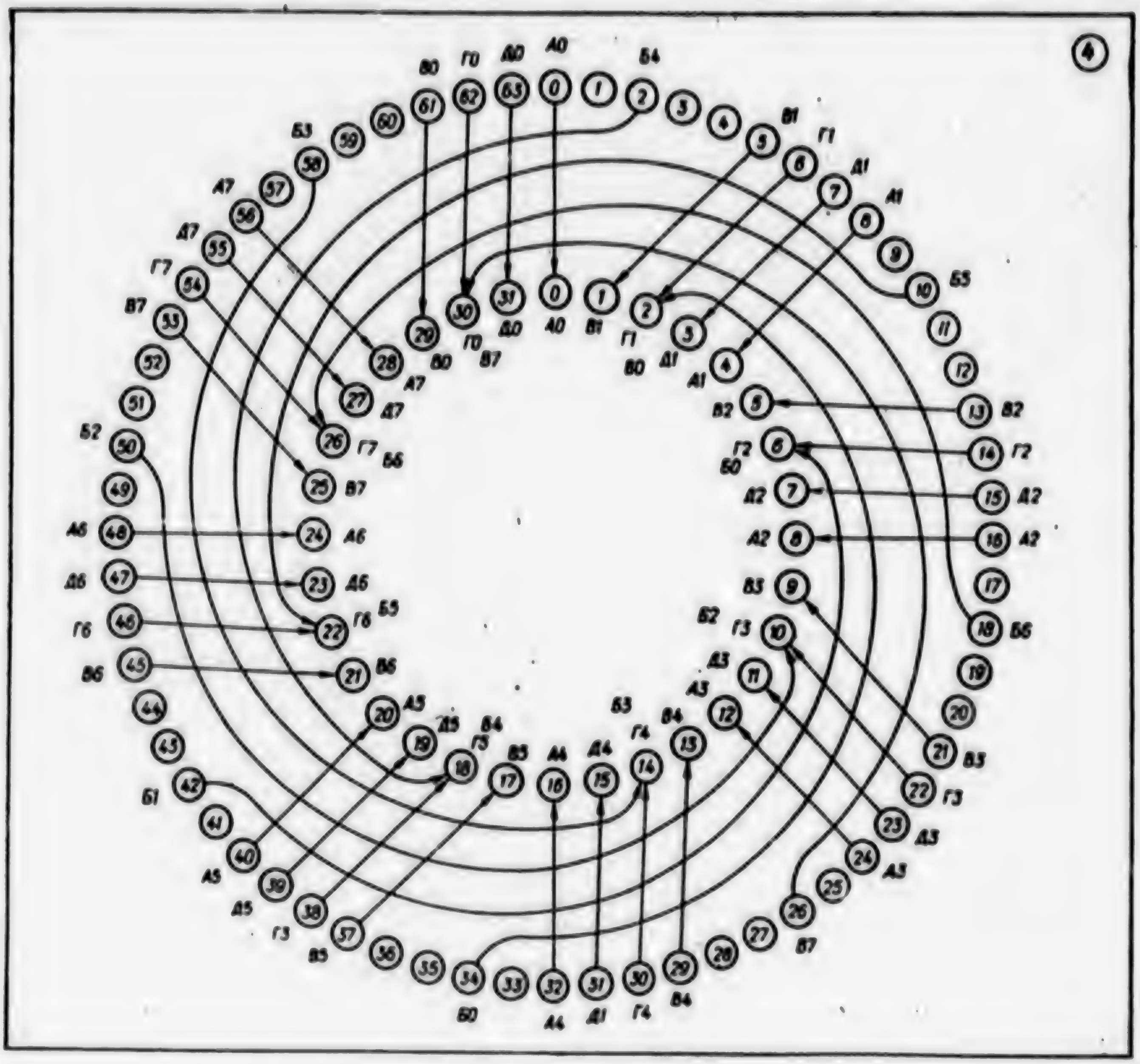


Figure 4. Graph of work and switchings showing required change of the control device time program.

According to the data of that table, by means of (1) the active states codes are determined which are written in binary and decimal forms in Table 5 in accordance with (2):

$$U_{\text{в}} = 1 + H_{\text{вос}} = 1 + 31 = 32,$$

$$U_{\text{р}} = 1 + H_{\text{асp}} = 1 + 63 = 64.$$

Table 4

i	ω		i	ω	
	p	θ		p	θ
1	2T	T	21	2T	T
2	3T	T	22	3T	T
3	T	O	23	T	O
4	T	T	24	T	T
5	T	T	25	T	T
6	2T	T	26	2T	T
7	3T	T	27	3T	T
8	T	O	28	T	O
9	T	T	29	T	T
10	T	T	30	T	T
11	2T	T	31	2T	T
12	3T	T	32	3T	T
13	T	O	33	T	O
14	T	T	34	T	T
15	T	T	35	T	T
16	2T	T	36	2T	T
17	3T	T	37	3T	T
18	T	O	38	T	O
19	T	T	39	T	T
20	T	T	40	T	T

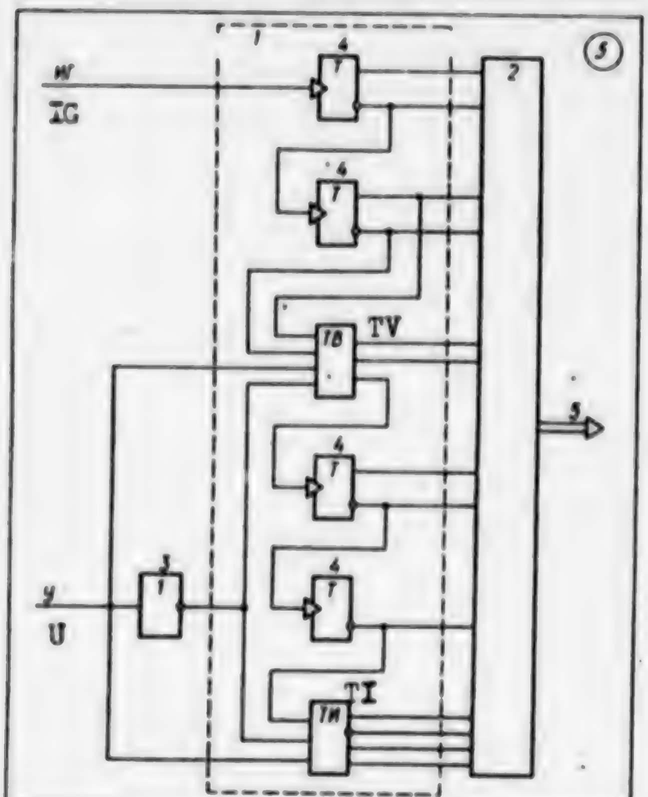


Figure 5. Schematic diagram of control device at N = 6, TV (j = 2) and TI (j = 5).

Table 5

CQ	Code of active state			
	→ p		→ θ	
	dec.	binary	dec.	binary
A А0	0	000000	0	00000
B Б4	2	000010	18	10010
C В1	5	000101	1	00001
D Г1	6	000110	2	00010
E Д1	7	000111	3	00011
А1	8	001000	4	00100
Б5	10	001010	22	10110
В2	13	001101	5	00101
Г2	14	001110	6	00110
Д2	15	001111	7	00111
А2	16	010000	8	01000
Б6	18	010010	26	11010
В3	21	010101	9	01001
Г3	22	010110	10	01010
Д3	23	010111	11	01011
А3	24	011000	12	01110
Б7	26	011010	30	11110
В4	29	011101	13	01101
Г4	30	011110	14	01110
Д4	31	011111	15	01111
А4	32	100000	16	10000
Б0	34	100010	2	00010
В5	37	100101	17	10001
Г5	38	100110	18	10010
Д5	39	100111	19	10011
А5	40	101000	20	10100
Б1	42	101010	6	00110
В6	45	101101	21	10101
Г6	46	101111	22	10110
Д6	47	101111	23	10111
А6	48	110000	24	11000
Б2	50	110010	10	01010
Б7	53	110101	25	11001
Г7	54	110110	26	11010
Д7	55	110111	27	11011
А7	56	111000	28	11100
Б3	58	111010	14	01110
В0	61	111101	29	11101
Г0	62	111110	30	11110
Д0	63	111111	31	11111
		$\|M_p\|$		$\|M_\theta\|$

Therefore from (4) it follows that

$$g_e = \log_2 U_e - 5,$$
$$g_p = \log_2 U_p - 6.$$

From which n_{TV} is determined according to (5):

$$n_{TB} = 6 - 5 = 1.$$

In compiling Table 5 we take as a basis the mode of operation with relay commutation, the active states of which are written in the order of increase of their codes, that is, in the order of their origination in time. The active states codes of a regime of operation with electronic commutation (ω = e) are written on the lines allocated to them in recording the codes of the mode taken as a basis. Thus in column 3 of Table 5 the matrix $\|M_p\|$ with the dimensions 40 x 6 is written, and in column 5 of the same table, matrix $\|M_e\|$ with the dimensions 40 x 5.

In the execution of operation (6) it turned out that $\|P_1\| = \|E_1\|$, $\|P_2\| = \|E_2\|$, $\|P_4\| = \|E_3\|$ and $\|P_5\| = \|E_4\|$. In the matrix $\|M_p\|$ two columns are detected: $\|P_0\|$ and $\|P_3\|$, which did not coincide with a single column of matrix $\|M_e\|$ and in matrix $\|M_e\|$, one column, $\|E_0\|$, which did not coincide with one column of matrix $\|M_p\|$. This means that one TI is necessary. Thus $n_a = 2$, $n_B = 1$, that is, $J_1 = 0$, $J_2 = 1$, $K_1 = 0$. Consequently, operation (10) must be performed twice: for $J_e = 0$, $K_B = 0$ and at $J_a = 3$, $K_B = 0$. As a result of its application we obtain $R_{11} = 8$, $R_{21} = 20$. Thus two sums are possible: $S_1 = R_{11} = 8$ and $S_2 = R_{21} = 20$. The smallest of these sums $S_{min} = R_{11} = 8$. This result means that the position of TI corresponds to $\|P_3\|$ and consequently that flip-flop must be in the highest position of the control device binary counter (j = 5). The position of TV corresponds to $\|P_3\|$, that is, it must be in the second position of the binary counter (j = 2). It is not difficult to determine the number of control signals that can be generated with use of the invertible output of the TI. It is equal to $R_{11} = 8$. This is the control signals B0 - B7 (see Table 3 and Figure 4).

Figure 5 shows a schematic diagram of a control device obtained by the above-described method. The control device consists of a binary counter 1, a decoder 2 and an inverter 3. The zero, first, third and fifth positions of the counter were executed on flip-flops 4 with counter inputs. TV is established in the second position, and TI in the fifth. The modes of operation of the control device are controlled by the signal U. In the given case U = UTV = UTI. The signal $\neg$U = = $\neg$UTV = $\neg$UTI arises on the output of inverter 3. The control device is actuated by 16 pulses arriving from the generator. The decoder 2 consists of 40 6-input I elements which produce control signals 5. If we use the order of the states written in the third column of Table 5 it is not difficult to determine the connections of inputs of those elements with the counter outputs.

Thus for the element I issuing signal B5 the code 001010 is written. It follows from this that four inputs of element I must be connected with zero outputs of the flip-flop: the zero position, the fourth position and the zero invertible TI output, and two inputs with "single" outputs of flip-flops of the first and third positions.

Thus the proposed method of synthesis of adjustable control devices based on the application of TV and TI consists of the following basic steps:

1. Construction of a Graph of Work and Switchings to determine the active states codes.
2. Compilation of the matrices $\|M_p\|$ and $\|M_e\|$.
3. Analysis of matrices $\|M_p\|$ and $\|M_e\|$ to determine the non-coinciding columns $\|P_j\|$ and $\|E_k\|$.
4. Comparative analysis of $\|P\|$ and $\|E_k\|$ and determination of matrix $\|R\|$.
5. Investigation of matrix $\|R\|$. Determination of the minimal sum S_{min}.
6. Determination of positions of TI and TV.

BIBLIOGRAPHY

1. Ordyntsev, V. M., and Khramov, A. D. "Automatic Compensating Multipoint Instrument for Measurement of Electric Values." USSR Author's Certificate No 220,356. BYULLETEN' IZOBRETENIY, 1968, No 20.

2. Ordyntsev, V. M., and Yan'shin, A. A. "Multichannel Measurement System Control Device." USSR Author's Certificate No 421,124. BYULLETEN' IZOBRETENIY, 1974, No 11.

3. Ordyntsev, V. M., Krasilova, N. A., Kuznetsova, A. I., et al. "Multichannel Measurement System Control Device With Address Sensor Selection." USSR Author's Certificate No 432,499. BYULLETEN' IZOBRETENIY, 1974, No 23.

4. Ordyntsev, V. M., and Slepova, S. S. "Multichannel Information-Measurement System Control Device." USSR Author's Certificate No 693,374. BYULLETEN' IZOBRETENIY, 1979, No 39.

5. Ordyntsev, V. M., Krasilova, N. A., Kuznetsova, A. I., et al. "Organization of Information Control and Exchange in a Large-scale Scientific Investigations Automation System With Computer." In book: "Avtomatizatsiya nauchnykh issledovaniy na osnove primeneniya EVM: Trudy konferentsii" [Automation of Scientific Investigations Based on Application of Computers: Proceedings of Conference]. Novosibirsk, 1974, p 314.

2174
CSO: 1863/11

AUTOMATED CONTROL SYSTEM FOR PETROCHEMICAL PROCESSES WORKING WELL

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Oct 81 p 2

[Article by A. Vorob'yev, Tol'yatti: "Computers on Duty"]

[Text] The technology for obtaining rubber is based on highly complex chemical processes. The aggressive media, explosive substances, and high temperatures and pressures must all be watched carefully. Under such conditions, it is possible to transfer control over the industrial processes to machinery? It is entirely possible, to judge by the experience of the Tol'yatti Sintezkauchuk Production Association.

E. Tul'chinskiy, chief engineer at the second plant, familiarized me with the control computer of the dimethyldioxane separation shop. It is not particularly fast by contemporary standards, just 200,000 operations a second. Moreover it has a small memory. Is it good enough for the plant?

"Under our conditions a large machine is not needed," Eduard Abramovich said. "But this 'old lady' does an enormous amount of work, monitoring several hundred parameters and producing dozens of control actions to affect the industrial processes. She keeps track of eight reactors and furnaces and two evaporators."

Based on a program set up by the engineers, the machine keeps track of the temperature in all zones of the reactors, opens and closes valves at calculated times and at a set pace, and monitors the use of steam, pressure, and raw materials expended. In addition it analyzes the ratio of reagents, the degree of conversion of the initial substance into isoprene, and much more. I asked V. Nevstruyev, chief of the shop, about the real impact of introducing the computer into production.

"A few years ago," he recalled, "furious arguments among the engineers broke out on occasion right here in this office. Sometimes the participants included the best specialists from the central plant laboratory, technical division, and general director's office. Scientists were often invited too, and together they would look for ways out of difficult situations. But now the mysteries are gone. The machine breaks everything down into simple phenomena, into real, clear details. And now we always know what to do if there is a breakdown in technology."

Nearby is the branch where they obtain butadiene, initial material from which rubber is synthesized. The computer is practically in full charge of the industrial process here, controlling a large number of pieces of equipment. The machine has 120 sensors in the shop; they are its "eyes" and "ears." Instructions are issued from the computer center to the technical units over 49 control channels. This work used to require 20 administrative workers.

Each one of them had his own nature, his own working style. Some would manage the process like artists, with a light touch, precisely, like virtuosos. Others would work vigorously, but carelessly, with mistakes. Dozens of external factors affect a person's working style. But the computer carrying out an assigned program works like a qualified specialist, maintaining exact temperature conditions and controlling the feeding of raw materials strictly. This made it possible to increase the productivity of the reactors 10-15 percent and to reduce energy expenditures and the use of reagents significantly.

Firm ties with specialists at the Voronezh Branch of the Special Design Bureau of Automation helped in this. This friendship has lasted for almost 10 years. The Voronezh specialists developed the architecture of the first system and sweated over writing the first algorithm alongside plant workers. They now maintain active sponsorship ties with production.

"The association is already operating 10 automatic control systems for industrial processes," doctor of chemical sciences I. Belgorodskiy, chief engineer of the association, explained. "They save 3 million rubles a year."

"It is strange but true," Yu. Filipchenko, chief of the automated control system division at the association, confirmed, "that even the most recent designs for petrochemical production do not envision the installation of automated control systems for industrial processes. I say this, if for no other reason, from the example of our new butyl rubber facility. It is being turned over at the end of the year with no control equipment at all. Maybe the designers are afraid of the high cost of the machinery? But after all, industrial processes in shops can also be controlled by the very inexpensive Elektronika-60 micromachines produced in Voronezh."

Here is another problem. We must work harder in the petrochemical sector to introduce control instruments with electrical outlets. Then they can be connected directly to the machinery. At the present time we have to install analogs, code convertors that convert pneumatic signals into electrical signals.

There is a great shortage of engineers. We are not receiving the necessary service personnel for production computer centers. Therefore, 20 engineers are at the present time operating 10 computer centers. This is far below the norm.

But the workers at the computer centers said with concern that their most pressing problems were "nowhere to get sensors," "no convertors at all," and "we do not even think about centralized cable deliveries."

A final point. In many respects the experience with introducing the automated control system for industrial processes is unique in the sector. But it could be successfully applied at identical production facilities in the country.

11,176
CSO: 1863/19

LATVIAN SSR ADMINISTRATIVE RAYON AUTOMATED DATA PROCESSING SYSTEM

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 17, No 5, Sep-Oct 81 (manuscript received 27 Oct 80) pp 992-1002

[From article by E.Ya. Vanags, O.P. Krastin', B.Ya. Mezhgaylis and A.K. Sprogis, Riga: "Experience of Creating an Automated Data Processing System for an Administrative Rayon"]

[Excerpt] Basic Principles of the Creation of an ASOD [Automated Data Processing System] for an Administrative Rayon

In the Latvian SSR the first phase of a standard automated data processing system (ASOD) has been put into industrial service, which was developed by using Valmierskiy Rayon as an example and is regarded as a component of the future Statewide Automated System for Gathering and Processing Information for Accounting, Planning and Control of the National Economy (the OGAS).

An important feature of this ASOD is the broader interpretation of a territorial ASU [automated control system] as compared with those created in other Union republics. This ASOD is pursuing the goal of improving the quality of control not only of the administrative rayon as a whole, but also of the enterprises and organizations situated in its territory. Besides, it must supply with the necessary information republic components of the Automated System for Planning Calculations (ASPR), the Automated System for State Statistics (ASGS) and other interindustrial, industrial and departmental ASU's. The general approach to constructing a territorial ASOD in the Latvian SSR is contained in the idea of the development of the OGAS and the Republic Automated Control System (RASU): The OGAS includes ASU's not only of the top (Union) level, but also of all lower levels, and the RASU includes both automated control systems for general republic purposes and all others located in the territory in question.

The organizational and technical base of an ASOD for an administrative rayon is the regional computing and data processing center (RIVTs) of the system of State statistics, which provides for all ASU's created in the rayon, as well as for the mechanization and automation of individual computing and accounting work for enterprises and organizations which do not have ASU's. A territorial computing center in an administrative rayon has a number of advantages over departmental computing centers: Services can be offered to all enterprises and organizations of the rayon, including medium-size and small; the possibility exists of steadily increasing production capacities and introducing the latest equipment; the more

intense and even utilization of equipment and personnel is made possible when processing data for institutions of various types for which deadlines for solving problems vary; the force of specialists is concentrated in a single place; capital investment is economized on; the .ost of data processing is reduced; and favorable conditions are created for effective interaction between all ASU's included in the rayon automated system. In turn maximum efficiency of the functioning of the RIVTs is achieved with the territorial uniting of all of its users.

Even today the RIVTs's of the system of State statistics in the Latvian SSR are quite large. In particular, the Valmierskiy RIVTs is situated in a new specially designed building with a working area of 2400 square meters and is furnished with an expanded-configuration YeS-1022 computer and a "Minsk-22", 50 punched-card computers, 38 automatic bookkeeping and billing machines, 81 adding machines and other equipment.

8831
CSO: 1863/29

TOMSK COLLECTIVE-USE COMPUTING CENTER

Moscow EKONOMICHESKAYA GAZETA in Russian No 41, Oct 81 p 16

[Article by V. Dubrovin, Tomsk: "Collective-Use Computing Center"]

[Text] The Tomsk Collective-Use Computing Center (VTsKP) is one of four which have been created in the USSR TsSU [Central Statistical Administration] system. The first phase of the center was put into service a year and a half ago. It includes a third-generation computer complex and extensive software making it possible to solve about 100 control problems. During a brief period by the united efforts of scientists and specialists the scientific methodological principles have been created for constructing a system for controlling such a complex socieconomic entity as an oblast.

"At the first stage we offered our services to control organizations as well as enterprises which are not able to have their own computing centers," relates VTsKP Deputy Director S. Vlasov. "Now we are ready to extend the range of services to larger entities also, including production associations."

In operation in enterprises and organizations of Tomskaya Oblast are about 40 computing centers having more than 100 computers, a fourth of which are third-generation machines, each of which costs almost a half million rubles. However, they are utilized a total of 6 to 8 h per 24-h period. At the same time these machines could operate in the multiprogram mode and solve not one but several problems at once for several users. Still many owners of computers use them in the single-program mode for solving only their own and not infrequently second-level control problems. The creation of collective-use computing centers has made it possible to increase severalfold the operating efficiency of computers.

It must be mentioned that existing indicators for evaluating the performance of a center do not orient its team toward the fuller utilization of computing equipment. The gross index remains the criterion, i.e., the computer utilization time in hours, and not the amount and quality of information put out.

"It is possible to solve in an hour and two or three times faster the same problem with different programs and different computer operating modes," says VTsKP Chief Engineer Yu. Davydov. Consequently, it would be more proper for the USSR Central Statistical Administration to revise the indicators for evaluating the performance of a center. It is possible even now to render services to a broader range of users. For example, considerable information on motor vehicle transportation in

the oblast is concentrated in the "Autosearch" subsystem, but only one GAI [State Motor Vehicle Inspectorate] uses it. Meanwhile these data could be useful to the Sel'khoztekhnika [Agricultural Equipment] Oblast Association for estimating the optimum spare parts requirement, to the Glavneftesnab [Main Administration for Transportation and Supplying Petroleum and Petroleum Products] Oblast Administration for establishing the demand for and overseeing the consumption of fuel and lubricants, and to other enterprises and organizations.

The center's capacity will increase fourfold with the startup of phase two of the VTsKP. The efficiency of its operation is also to increase by a high factor.

8831
CSO: 1863/29

TECHNOLOGY IN USE AND CONTEMPLATED AT CSA COMPUTER CENTERS

Moscow VESTNIK STATISTIKI in Russian No 9, Sep 81 pp 45-50

[Article by M. Lermontov, S. Tiokhin and O. Fedorov: "Material-Technical Support of the Automated System of State Statistics (ASGS) and Improving Management of It"]

[Text] The computer network of the USSR Central Statistical Administration (CSA) is one of the largest insectorial information and computing systems in the country. It includes about 2,900 computer installations whose technical base supports the solving of statistical problems and performance of computing work for enterprises and organizations of different sectors of the national economy.

The USSR CSA computer system is constructed on the hierarchical principle and has four levels (USSR, republic, oblast, and rayon).

At the USSR level there is the Main Computer Center of USSR CSA with powerful high-speed computer technology. In the 11th Five-Year Plan it will receive powerful YeS EVM-2 [Unified System of Computers-2] machines: the YeS-1060 (productivity of 1 million ops/sec and main memory volume of up to eight megabytes) and the YeS-1055 (productivity of 450,000 ops/sec and main memory of up to four megabytes).

At the republic level there are 15 republic computer centers at which YeS EVM-2 computers will also be installed: YeS-1045 (productivity of 10-500,000 ops/sec and main memory of up to three megabytes) and YeS-1035 (productivity of 125,000-200,000 ops/sec and main memory of up to one megabyte).

The oblast level is represented by the computer centers of the statistical administrations of the krays, oblasts, and autonomous SSR's, which will be supplied chiefly with YeS-1035, YeS-1033, and YeS-1022 machines.

The computer centers at the rayon levels will use M5010 and M5100 punchcard computer complexes. In the future the series M5000 (5010, 5100) punchcard complexes will be replaced with the new SM-1600 model.

In the current five-year plan the computer system of USSR CSA will begin using SM-4 minicomputers. In addition, an experiment will be made with setting up rayon

distributed computer systems based on Elektronika-60 and Elektronika-100/25 minicomputers.

Special attention should be given to the continued development of collective-use computer centers. There will be further development of such centers in Minsk, Tallinn, Tomsk, and Tula. In addition to these centers, new collective-use computer centers based on YeS-1045 computers will be set up in Alma-Ata, Vilnius, Kiev, Frunze, Voronezh, Vinnitsa, L'vov, and Saratov.

The computer centers of USSR CSA that are in operation and being set up will also be supplied with various new types of peripheral equipment: the YeS-5061 (capacity of 29 megabytes), YeS-5066 (capacity of 100 megabytes), and YeS-5067 (capacity of 200 megabytes) replaceable magnetic disk stores. Minicomputers will be equipped with YeS-5069 (capacity of 25-50 megabytes) and YeS-5074 (capacity of 3.2 megabytes) replaceable magnetic disk stores.

The computer centers will also receive the new YeS-5012 and YeS-5017 magnetic tape stores, YeS-7032 printers (printing speed of 900 lines/minute), and YeS-7033 (printing speed of 600-1,100 lines/minute) printers, and YeS-6019 card feeders (capable of feeding up to 1,200 cards a minute).

Remote data processing technology and automated data banks will receive special development in the 11th Five-Year Plan. Their use will promote an increase in the efficiency of use of computer technology and information resources.

The computer centers, above all the collective-use centers, will be supplied with the following types of remote data processing equipment: YeS-8400 data transmission multiplexors (transmission speed of up to 15 bits/second on telegraph channels and 2,400 bits/second on telephone channels) and YeS-8403 multiplexors (transmission speed of 50-4,800 bits/second); YeS-8010 modems (data transmission speed of 75-2,400 bits/second), YeS-8030 telegraph signal conversion devices (data transmission speed of up to 200 bits/second), YeS-8504 (data transmission speed of 2,400 bits/second), and YeS-8504 (data transmission speed of 1,200-4,800 bits/second) user stations, and YeS-7920-00 (or 01, 10, and 11) group display stations which can connect in up to 32 YeS-7927-01 units.

Devices to prepare data on magnetic data media will also be introduced: on YeS-9002 (recording density of 32 bits/millimeter), YeS-9004, and YeS-9003 (recording density of 32 bits/millimeters, 4-16 data collection consoles) magnetic tape and on YeS-9112 magnetic disks (recording unit length of 1-128 characters).

Instead of punchcard computers series production of domestic Iskra-534, Iskra-555 (for modifications), and Iskra-2106 electronic invoice-bookkeeping machines will begin.

The Iskra-555 invoice-bookkeeping machine is designed to automate statistical, accounting, bookkeeping, and operational record-keeping problems. This machine comes with different sets of peripheral devices: magnetic tape storage, flexible magnetic disks, rigid magnetic disks, tape punches, and the like. The speed of the Iskra-555 is about 4,000 ops/second and the printer prints 100 characters a second.

The computer system of USSR CSA has been receiving Robotron-1720 automatic invoice-bookkeeping machines since 1979. They have a memory capacity of 128 64-bit words, storage on a YeS-5074.01 flexible magnetic disk, and a Daro-1156 sequential printer (printing speed of 100 characters per second).

The Daro-1373 and Daro-1372 programmable electronic data preparation units are designed to receive a machine data medium on punched tape or magnetic tape in a minicassette. They have a main memory of two kilobytes, a Daro-1156 alphanumeric printer, a Daro-1215 tape punch, and storage on a YeS-5074.01 flexible magnetic disk (disk capacity is 3.2 megabytes).

11,176
CSO: 1863/15

NEW STEPS TOWARD REMOTE DATA PROCESSING IN STATE STATISTICS SYSTEM

Moscow VESTNIK STATISTIKI in Russian No 9, Sep 81 pp 50-54

[Article by V. Chizh, S. Shul'gin and V. Yashin: "Remote Processing of Statistical Information in the Automated System of State Statistics (ASGS) and Ways to Develop It"]

[Text] The problems of collecting and processing information in the second stage of the ASGS under conditions of shared use of computer technology and data transmission over communications channels are being solved by the hardware and software of STOSI, the System for Remote Processing of Statistical Information which was developed by the Scientific Research Institute of the USSR Central Statistical Administration (CSA), the All-Union State Planning-Technological Institute of USSR CSA, the Main Computer Center of USSR CSA, the republic collective-use computer centers of the central statistical administrations of Belorussia and Estonia, and the republic computer centers of the RSFSR and Ukrainian central statistical administrations. In terms of architecture STOSI is formulated as a multicentric system in which the computers of the computer centers of the USSR CSA system are linked to communications channels to carry on intermachine exchange and connect to user terminals (teletypes, user points, and local group display stations). The STOSI is oriented to performance of the following jobs: remote batch processing of statistical information by electronic data processing complexes with data exchange in the computer-computer mode; collection of data from users at the computer center in the modes user station-computer and user station-computer-computer, for subsequent batch processing of the data; the distribution of the workload among computer centers in the computer-computer mode; remote access to the automated data banks of the integrated data storage and processing systems of the ASGS in the user station-computer and user station-computer-computer mode with the help of local displays and user stations at the disposal of the users; data exchange among automated data banks of different levels of the ASGS in the computer-computer mode; exchange of information (arrays of data, programs, and the like) among computer centers in the computer-computer mode; single-address and multiaddress transmission of data in conformity with its priority in the user station-computer, user station-computer-computer, user station-computer-user station, and user station-computer-computer-user station modes; carrying on work conversations among users in the user station-computer-user station and user station-computer-computer-user station modes.

In the STOSI the services are performed with due regard for the requirements of reliability, economy, and convenience of developing the architecture of the system and making maximum use of the capacities of the State Data Transmission System (OGSPD) and YeS [Unified System] computers. At the oblast and republic levels of the USSR CSA system the STOSI uses switchable telegraph and telephone communications channels for data collection and transmission, while for collection and transmission among the Main Computer Center of USSR CSA and the republic computer centers of the Union Republic central statistical administrations non-switchable intercity communications channels are used. The principal remote processing means are data transmission devices, user stations, data transmission multiplexors, and — in the future, remote data processing processors of the Unified System.

Figure 1 below represents the generalized structure of the STOSI. According to the structure, interaction of YeS or Minsk-32 computers of the computer centers

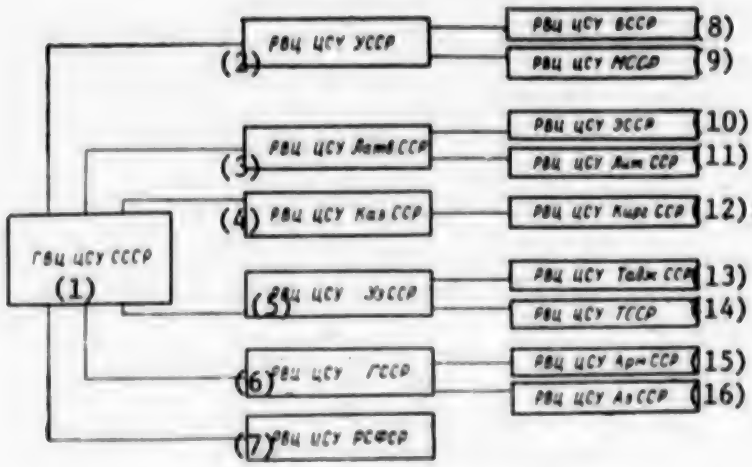


Figure 1. Generalized Structure of the STOSI.

Key: (1) Main Computer Center of USSR Central Statistical Administration (CSA);
(2) Republic Computer Center of Ukrainian SSR CSA;
(3) Republic Computer Center of Latvian SSR CSA:
(4) Republic Computer Center of Kazakh SSR CSA;
(5) Republic Computer Center of Uzbek SSR CSA;
(6) Republic Computer Center of Georgian SSR CSA:
(7) Republic Computer Center of RSFSR SSR CSA;
(8) Republic Computer Center of Belorussian SSR CSA;
(9) Republic Computer Center of Moldavian SSR CSA:
(10) Republic Computer Center of Estonian SSR CSA:
(11) Republic Computer Center of Lithuanian SSR CSA;
(12) Republic Computer Center of Kirghiz SSR CSA;
(13) Republic Computer Center of Tajik SSR CSA;
(14) Republic Computer Center of Turkmen SSR CSA;
(15) Republic Computer Center of Armenian SSR CSA;
(16) Republic Computer Center of Azerbaijan SSR CSA.

of the oblast or republic levels is accomplished by means of DS Ye-550 data transmission apparatus, while on the republic and USSR levels YeS computer remote processing equipment is used. Figure 2 below shows the projected scheme of communication between the computer centers of the USSR and republic levels of STOSI. At each of these computer centers the computers are interlinked with communications channels through YeS-8403 data processing multiplexors and YeS-8010 modems to transmit data at a speed of 2,400 bits per second. YeS-7906 and YeS-7920 display stations are used as terminals, and the use of YeS user stations, for the most part display-type units such as the YeS-8564, is contemplated.

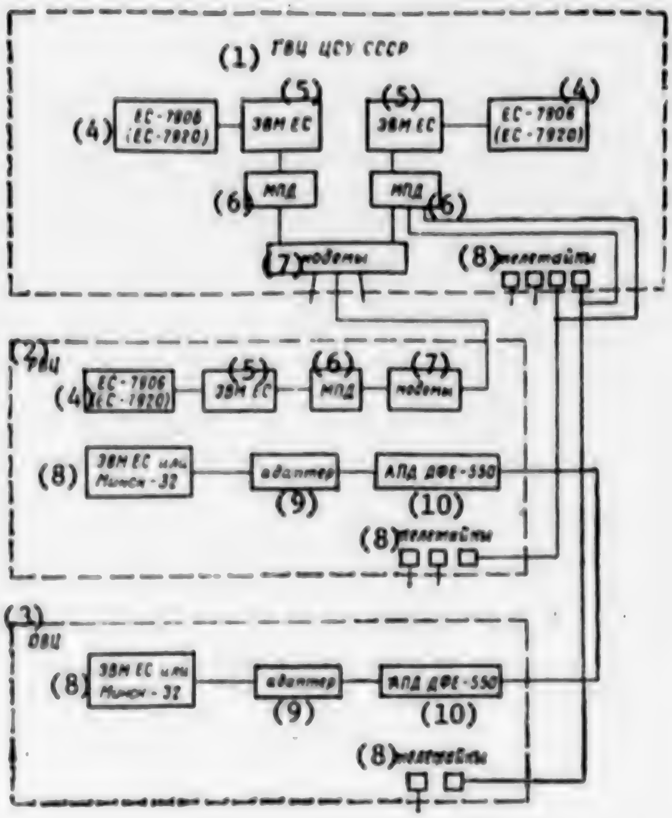


Figure 2. Diagram of the Linkages Among Computer Centers on the USSR and Republic Levels of the STOSI.

Key:
- (1) Main Computer Center of USSR CSA:
- (2) Republic Computer Center;
- (3) Oblast Computer Center;
- (4) YeS-7906 (YeS-7920);
- (5) YeS Computer;
- (6) Data Transmission Multiplexor;
- (7) Modems;
- (8) Teletypes;
- (9) Adapter;
- (10) DFYe-550 Data Transmission Apparatus.

Special software is used to accomplish the intermachine connection in cases where Minsk-32 computers and Unified System computers are connected through DFYe-550 data transmission apparatus to switchable telephone channels. The introduction of YeS remote processing equipment required the development of qualitatively new software to raise the level of automation of the processes of information exchange, software that would permit the ASGS to interact with other automated systems, above all automated systems for planning calculations, thus providing remote access to the resources of ASGS automated data banks. The data switching software of the STOSI permits the construction of a computer network based on YeS resources and has greater capacities than existing remote processing software.

Performing the tasks of the STOSI requires not only the user station-computer mode for local access to automated data banks or interactive work by an economist and the computer during input monitoring, but also remote access to the data bank in the user station-computer-computer mode when working through the user and inter-center network or when data is being collected at the Main Computer Center from the oblast computer centers; the computer-computer mode for remote processing of statistical information by electronic data processing complexes; user station-computer-user station and user station-computer-computer-user station modes for carrying on service conversations between the personnel of different computer centers taking part in remote processing of statistical information (these two modes are extremely essential for controlling the work of the STOSI).

Beginning from the basic telecommunications method of access for the YeS disk operating system and the general telecommunications access method for the YeS operating system, corresponding software for information switching was developed. It is based on communications protocols for remote access to ASGS resources. These protocols define the set of agreements that formulate procedures for communication between sources and receivers of data in different sectors of the STOSI.

The processes realized in the STOSI are carried on with the aid of virtual channels, which represent the logical connection between the source of information and the receiver to insure identical user access to the resources of the system regardless of the construction of data transmission channels. The realization of communications by virtual channels, which are sets of queues in the computers for physical channels, makes it possible to serve several STOSI users at the same time in each intercenter communications channel. This is a new and very important feature, because the STOSI uses a configuration radiating from a center for communication among centers and in this system not all republic computer centers have direct communication with the Main Computer Center. This new feature enables them to have the same capacities as those republic computer centers that are connected to the Main Computer Station by direct data transmission channels. Moreover, with this approach to the design of the STOSI it becomes possible at the same time to carry on both slow processes of the user station-computer-computer or user station-computer-computer-user station type and fast processes such as the computer-computer type. All this is achieved by using batch switching in the STOSI. This makes it possible to reduce the volume of service information in the STOSI to five percent, whereas with YeS software its proportion is significantly greater.

It is contemplated that 37 electronic data processing complexes will be switched to remote processing before 1983. These complexes were chosen in such a way that the volume of information from the republic computer centers of the Union republic central statistical administrations (without the republic computer center of the RSFSR CSA) was greater than 50 percent. Considering this, the volume of information transmitted to the Main Computer Center of USSR GSA for the complexes chosen is 30.2 percent from the republic computer center of the RSFSR CSA, 9.9 percent from the republic computer center of the Ukrainian SSR CSA, and 7.2 percent from the republic computer center of the Kazakh SSR CSA. The proportion of information from the republic collective-use computer center of Belorussian SSR CSA and the republic computer centers of the central statistical administration of the Uzbek SSR, Latvian SSR, and Azerbaijan SSR ranges from 5 to 5.4 percent; the range is 3.2-4.4 percent for information from the republic computer centers of the central statistical administrations of the other republics.

The volumes of predicted information flows in the STOSI by months will not be distributed evenly. The month of greatest load on the STOSI will be March (this month accounts for 20.3 percent of the volume of information in a year), while the month of least load is June. The day with the greatest load on the STOSI will also be in March (the information flow on this day accounts for 5.4 percent of the information volume for the year). In addition to this volume of information based on electronic data processing complexes information will be circulating constantly in the STOSI on access to automated data banks in the user station-computer and user station-computer-computer modes and carrying on service communications in the user station-computer-user station and user station-computer-computer-user station modes. The volume of this information on the day of the greatest load will be up to 20 percent of its total volume, equal to 16.5 million characters.

With these loads it is contemplated that the following basic operating-technical characteristics of the STOSI can be maintained: error coefficient by characters of at least 10^{-6}; average transmission time for one batch with a volume of 128 characters and a data transmission speed of 2,400 bits per second between the Main Computer Center and any republic computer center can be about one second; delay coefficient in delivery time of batches at hours of peak load with a data transmission speed of 2,400 bits per second — on the order of five.

System measurement resources based on automatic logging of data receipt and transmission in each computer linked with communications channels is envisioned to obtain the appropriate operating-technical characteristics of the STOSI. Using these means detailed information can be collected for each computer center on the time that the data reaches the computer center, the waiting time until it starts to be transmitted to the outgoing channel, and the number of batches and messages fed and transmitted for each mode and user individually. In addition, expenditures of main and external computer memory to carry out remote data processing procedures are estimated with identification of resource expenditure for switching data. This information is used both for operational control of the work of the STOSI and for development of recommendations on improving its architecture. The information is collected by an automated system to account for use of computer center resources.

The composition of the STOSI envisions solving a broad range of problems related to controlling the processes of data switching and remote processing. These tasks are broken down into two primary classes which are realized by means of directive messages from users and STOSI administrators. All the user must do to establish a connection in the STOSI is to send the directive message "COMMUNICATION" with the address of the sender, that is the user himself, in the service part of the message, and the address of the receiver determines the program component, for example the automated data bank of the ASGS integrated system for data storage and processing or the terminal of a STOSI user. Completion of communication is accomplished by sending the message "COMMUNICATION COMPLETED" without giving the address part.

When data is transmitted by electronic data processing complexes or interbank data exchange in the computer-computer mode is carried on, only the STOSI administrator of each computer center initiates intermachine communication. In order to preclude unsanctioned access to the information of the electronic data processing complexes and automated data bank of the ASGS integrated system for data storage and processing, these services are not offered to STOSI users. These services are realized by corresponding directive messages from STOSI administrators to establish communication at the beginning of an intermachine communication session, and also to stop it after the transmission of files has been completed. To insure reliable delivery of the information the STOSI envisions the possibility of stopping the transmission of files on the order of the STOSI administrator and starting up the transmission again from a point indicated by the sender or receiver of the information. Allowing data receivers this possibility of additional recording makes it unnecessary to repeat the entire transmission.

Using the set of directive messages STOSI administrators are able to track and control the processes of remote data processing and switching in a flexible manner. The software of the general telecommunications method of access and means specially developed for STOSI needs are used together here. The former are figured to control work within the limits of a single computer center, while the latter are designed for the possibility of an interrupt or precluding connections to the STOSI as a whole. In this case the STOSI administrator of each computer center will be given such a possibility without stopping the work of the entire system, while the main STOSI administrator, as the Main Computer Center of USSR CSA, will have the capability of automatically stopping or restarting the work of the entire STOSI. Among these means are also programs for automatic testing of the work of STOSI hardware under control of the YeS operating system.

The hardware and software that realize these capabilities were tested in 1980 in the experimental component of STOSI, which included the Main Computer Center of USSR CSA and the republic computer centers of the central statistical administrations of the Ukraine, Belorussia, and Estonia. In 1981 the republic computer center of the Latvian SSR CSA was connected in. These computer centers are interconnected by nonswitchable intercity telephone channels with four-line terminals: Moscow-Minsk, Moscow-Tallinn, Tallinn-Riga, and Minsk-Kiev. Experience with operating them showed that the principal factor that affects the quality of STOSI work is the reliability of the hardware, above all the computers.

The development of the remote data processing system in 1982-1985 will be directed to expanding its functional capabilities and increasing the scale of the system to more fully satisfy the needs of the ASGS and collective-use computer centers for remote data processing. The development of hardware and software will be concentrated on setting up a corrective-use computer network, which is an adaptive remote data processing system with expanding architecture (ASTORA) with four program levels. The first level will include the system software to establish the permanent and variable virtual connections in the system. The second will include the resources of the automated data bank of the ASGS integrated data storage and processing system. The third will include interfaces with the remote data processing programs in the user station-computer, user station-computer-computer, and computer-computer modes. The fourth level will include remote data processing programs that contain specific and system software for the ASGS and users of the collective-use computer centers.

The system data switching software should make it possible to establish permanent and variable virtual connections and to transmit single-address and multi-address messages. It will be a further elaboration of the data switching software operating system with permanent virtual connections within the limits of a pre-assigned schedule for insuring remote access to the resources of the ASGS, above all the automated data bank of the ASGS integrated data storage and processing system. These permanent virtual connections will also be used for simultaneous multiple remote access to similar resources of the computers of the collective-use computer centers, for example for interactive, prolonged feeding of assignments, and the like. These connections will be established by the system itself, while only users or system administrators will establish the variable connections.

The system must provide an interface with the automated data bank of the ASGS integrated data storage and processing system and allow users access to the data bank under conditions where permanent or variable virtual messages are used in the "catalogued query," "query-response," "dialogue," and "expanded dialogue" modes. Information will be exchanged between automated data banks of different levels of the ASGS and the collective-use computer center on permanent virtual connections.

Users will be connected to systems software by means of developed interfaces for system remote processing software. This will permit users direct access to the system for batch or interactive remote data processing. It is envisioned that when necessary the interface should connect in only programs figured for the batch mode for remote data processing. In this case each user will be given the possibility of using those interface means which are realized in standard form within the framework of the general telecommunications method of access to YeS computer resources where they are working simultaneously with specialized systems equipment. All this will allow a significant broadening of the functional capabilities of the system and will permit solving the numerous problems of the ASGS and collective-use computer centers of the USSR CSA system.

The trends and capabilities of the OGSPD (State Data Transmission System) and the Unified System (YeS) of Computers are being taken into account in developing the ASTORA system. The system envisions broad use of the time-sharing mode, which

makes it possible to expand the scale of service to users. One of the most important economic factors which led to this development was the fact that transmission of one character on nonswitchable intercity telephone communications channels between the Main Computer Center and any republic center in all modes at a speed of 600 bits per second is no more expensive than transmitting it by the subscriber telegraph system, and when the transmission speed rises to 2,400 bits per second it will be cheaper.

The introduction of display complexes that include local and remote display stations for remote access to computer resources with the main memory of at least 1 million bytes at the USSR, republic, and (in part) oblast levels of the USSR state CSA system is an important task of the ASTORA system. This is the main guarantee of successful introduction of the means and methods of remote data processing being developed in the ASGS, above all for work with the ASGS automated data bank. A second important problem is the development of intermachine communications. The resources of the ASTORA system are multifunctional and automate the processes of information exchange among computers in the interests of both the electronic data processing complexes and the ASGS automated data bank and collective use computer centers as much as possible.

At the same time, the hardware and software of the ASTORA system will be the basis for solving a whole set of problems at collective-use computer centers, including the problems of controlling the user network. Under conditions where adaptive remote processing means are used, computer center personnel will be spared the work of programming systemwide problems for the computer centers: automated data banks, data collection (above all telegraph statistical reporting), data switching, service communications between users or different centers, system measurements, automation of accounting for use of computer resources, and other mandatory functions. All essential software will be delivered by the developers of the ASTORA system and generated for computer centers and collective-use computer centers with due regard for their current needs and developmental prospects.

Concurrently with carrying out these jobs to devise adaptive remote data processing means for computer centers and collective-use computer centers, the problems of improving STOSI communications protocols will be solved. Work toward this end indeed has begun at the republic collective-use computer center of the Estonian SSR Central Statistical Administration, where they are testing hardware and software for YeS computers functioning in conformity with international recommendations X. 25. This work aims at creating a highly developed network of computers that meets the requirements of the ASGS and the collective-use computer centers within the system of the USSR Central Statistical Administration. Their introduction will make it possible to increase the speed and reliability of data transmission, raise the level of automation of data collection and processing, and begin the transition to the conception of system remote data processing.

11,176
CSO: 1863/15

GOSBANK GORKOVSKAYA OBLAST OFFICE COMPUTING CENTER IMPROVEMENTS URGED

Moscow DEN'GI I KREDIT in Russian No 9, Sep 81 pp 14-18

[Article by G.I. Koltashev, Gosbank Gorkovskaya Oblast Office manager, and R.M. Kalinkin, computing center director: "Improvement of Effectiveness of Computers"]

[Text] The 26th CPSU Congress stipulated as one of the main objectives for 1981-1985 and for the period up to 1990 the ojective of improving planning and control of the country's economy. At the present time automated systems are being created for gathering and processing information for accounting, planning and control of the national economy at the Union, republic and oblast levels.

The introduction of computers is an important and necessary matter. The operations of computing centers in Gosbank have demonstrated convincingly how effective their organization is. In seven years of industrial use the computing center of the Gorkovskaya Oblast office has converted to the processing of information on computers 40 Gosbank institutions in Gorkovskaya Oblast and 5 in Vladimirskaya. At the present time the average daily amount of information relating just to the "Operating Day" problem comprises 92.5 percent of the total number of documents arriving at Gosbank institutions in Gorkovskaya Oblast and 50 percent in Vladimirskaya. A total of six problems are solved on the computer: "Operating Day," "Control of MFO [Interbranch Turnover]," "Receipting of MFO," "Transfer of Pensions to Savings Bank," "Payment Transaction Accounting" and "Statistical Reporting." The total amount of information for all these problems equals about 90,000 documents per day. In addition, about 110 different forms and records are issued relating to these problems, the majority of which are for Gosbank institutions and office divisions. With the introduction of computers and other calculating and computing equipment working conditions have changed considerably, especially in the operations accounting work section. These measures have not only stopped the growth of the number of this category of worker in our office but have made it possible to reduce it by five percent in the last five years.

The center's specialists have put in no small amount of work to ensure the efficient operation of the computing complex. During the time of its operation dozens of efficiency suggestions have been introduced whose introduction made it possible to create a savings amounting to dozens of thousands of rubles. For example, of course, at the beginning of the organization of the computing center information from Gosbank institutions arrived by the delivery of punched cards from urban institutions and through communications channels with an entry also on punched cards by means of punches installed at the computing center. With this the annual

consumption of punched cards exceeded 28 million. This sort of information gathering was complicated and expensive and in addition it did not make it possible to increase the number of Gosbank institutions served by computers, firstly because of the lack of space for the installation of punches and secondly because of the need for additional staff.

Taking these complications into account, we carried out measures for the reception of information from Gosbank institutions through communications channels with its entry onto punched tape, in connection with which the necessity of using punches and punched-card verifiers was done away with and the consumption of punched cards was reduced to a minimum. A method of transferring information from Gosbank institutions directly to computers was introduced in our computing center beginning in April 1980. The information received by the computers is checked, recoded and entered onto magnetic tape. A check is performed by means of the computer's software. A communication regarding errors discovered is sent at once to the operator who committed the error, to the Gosbank institution through a communications channel. The information transfer process is carried out in the mode of a dialogue between the operator and computer concerning the quality of the information transferred.

The information transfer process is divided into two stages: The first is the preparation of documents for the day in keeping with existing formats, using the control group; the second is the transfer of information through communications channels by means of telegraph equipment. Practical experience in working by this method has demonstrated its distinct advantages over the prior method of inputing information by means of punched cards and punched tape.

In those Gosbank institutions in which the job of transferring information has been properly organized, the new method is especially effective, primarily in connection with the fact that the working conditions of operators have changed and telephone conversations relating to the verification of information have been shortened, and where skilled operators are working in this section and information is transmitted to computers rapidly and is of good quality, the transfer of information is completed in these Gosbank institutions no later than 1400 to 1500 h.

In our opinion changes should be introduced in the work force schedule of Gosbank institutions, having provided in them the post of telegraph operators with a piece-rate system of compensation. This in our opinion will be conducive to improving labor productivity as well as to improving the quality of information transmitted. The quality of information in turn has a direct influence on improvement of the labor productivity of telegraph operators, since in the improper transmission of information additional time is spent on correcting errors in documents arriving from the control group.

Introduction of the method of inputing information directly into computers was preceded by a great amount of work. The center's specialists installed and debugged equipment, installed teleprinters and organized the training of Gosbank institution workers in methods of transmitting information through communications channels by means of telegraph sets.

The method of direct input of information into the computer has made it possible to begin solving a problem 1 to 2 h earlier and to reduce considerably the time for

solving it. Whereas with the previous method of inputing information the solution to a problem was completed, as a rule, in 24 h, now the solution is completed considerably earlier and this has made it possible to send at the proper time processed information to Gosbank institutions. In addition, advice notes have begun to be prepared 1.5 to 2 h earlier, which has made it possible to improve working conditions for the MFO and forwarding group; they have begun to send advice notes at the proper time and the hurry has been eliminated, in connection with which the number of errors in sending them has been reduced.

The introduction of the method of direct input of information into the computer has of course caused certain expenditures, chiefly for the acquisition of telegraph sets and other additional equipment, but all the expenditures produced, according to our preliminary estimates, are recovered in two years and in the future a savings amounting to about 300,000 rubles per year will be formed.

On account of the introduction of the method of the direct input of information into the computer, part of the workers in information reception, input and verification sections have been released and they have been sent to other sections for purposes of expanding the range of problems which can be solved, increasing the amount of information which can be processed.

Of no small importance also is the fact that this method has freed operators from unnecessary work in the preparation of information. The operator's contact with the computer makes this work more intellectual and attractive. The very fact of a dialogue between a human being and a computer is of great value incentivewise and emotionally. And finally the introduction of this method in the future without added expenditures will make possible the reverse transfer of information from the computing center to Gosbank institutions, which will produce an added savings.

Our office's computing center is in the big three among Gosbank computing centers in terms of the number of institutions served and the amount of information relating to problems solved. It performs its work in three major directions: automated data processing, mechanized data processing and servicing of computing equipment.

Automated data processing employing computers is performed in the following aspects: the solution of problems which are put into industrial service; introduction of new tasks into experimental use and then into industrial service; the development of new tasks upon assignment from the main computing center; the improvement of programs for problems solved for the purpose of improving their utilization characteristics; the performance of tests after revisions and changes in programs arriving from other computing centers; improvement of the hardware of the computing complex and communications equipment necessary for the transmission of information to the computing center; and the on-line servicing of computers and communications equipment.

The computing center systematically does work on improving the software of the "Bank" system.

In addition to the improvement of software, there has also been improvement of hardware. The computing center has put into service additional magnetic drums, punched tape input units and punched tape output units and in addition has installed

an on-line storage unit, tape transports and printers. In addition dozens of various efficiency suggestions have been developed and introduced.

The computing center does the following for purposes of the mechanized processing of economic and bookkeeping information: the development and supplying of the required technical documentation for Gosbank institutions relating to the performance of new kinds of work upon assignment from the office's management; the training of department personnel in rules for the operation of mechanization equipment, including methods of programming for automatic bookkeeping machines, within the limits of the personnel training plan approved by the office; in necessary situations rendering practical assistance to Gosbank institutions relating to the introduction of mechanized data processing; and, using "Askota-170" automatic bookkeeping machines, work relating to writing summary statistical reports for presentation to superior organizations and for sector divisions of the office.

These kinds of work are performed on automatic bookkeeping machines by personnel of the computing department according to a specially developed schedule, and the introduction of the mechanized processing of economic and bookkeeping information in Gosbank institutions, in keeping with measures developed by the office.

The office began to be occupied a long time ago with the mechanization of credit economics work. At the present time 235 different kinds of jobs are performed through mechanization. The computing center's computer technology department does 136 kinds of jobs using automatic bookkeeping machines and there are 3000 different developments per year. The labor intensiveness of this work alone, performed for the office's administration, is about 8000 man-hours per year.

For the high-quality performance of the mechanized processing of information, skilled specialists--machine operators--have been set aside in each Gosbank institution; this category of worker takes courses organized by the computing center. In 1978-1979 67 machine operators trained in working with automatic bookkeeping machines and other computing equipment were trained at the computing center. At the same time the computing center's specialists visit Gobank institutions for the purpose of offering practical assistance to machine operators.

The computing center does a great amount of work on providing servicing for all the calculating and computing equipment used in Gosbank institutions. All preventive and repair work is done at the proper time and with good quality in keeping with developed schedules. For the on-line servicing of computing equipment in the oblast 15 rayon service stations have been set up at which 21 servicemen work and 39 Gosbank divisions and 315 savings banks are assigned to them with a total amount of equipment of different models of more than 3000 units. However, the lack of mobile service stations has reduced the efficiency of the servicing of computing and office equipment. The need has become acute of the centralized furnishing of computing centers with standard repair shops based on a UAZ-452 vehicle. Other difficulties are also encountered in the job of servicing all the calculating and computing equipment, the main one of which is the inadequate supply of spare parts. In addition to the performance of repairs by the computing center's servicemen, individual more complicated kinds of repairs or major overhauls are done by the USSR Gosbank Moscow Experimental Plant for the Repair of Computing and Office Equipment, which, unfortunately, also does not fully satisfy our needs.

During the 10th Five-Year Plan period subscriber's telegraph communications were developed extensively in the office. Suffice it to say that from the few subscriber units which existed at the beginning of the five-year plan period their number has grown to 32. They are in practically all the largest Gosbank institutions. The appropriateness of their use for large divisions is undisputed.

Our office's computing center as early as 1977 upon assignment from the main computing center did a great amount of work on the introduction of intercenter information exchange (MTsO) and for this purpose special equipment of the concentrator type was installed and tests were performed with Gosbank's Rostovskaya Oblast office, which demonstrated the feasibility of this method. Its introduction will be conducive to speeding calculations in operations and to freeing the considerable sum of credits issued for these purposes.

The number of computing centers in the Gosbank system is growing steadily and the majority of them have reached the required utilization of computers, in connection with which the problem of economizing on the machine time which is required for the timely processing of information and the creation of normal working conditions has arisen in these centers. In connection with the increase in the amount of information to be processed on account of the acceptance of new Gosbank institutions to be served and the increase in the range of problems to be solved, already at this stage a need has been created to replace the computers with more productive ones.

Operating experience has demonstrated that a more acceptable way of creating a machine time reserve is the transfer of the maximum possible number of solution steps requiring a considerable amount of machine time from magnetic tape to magnetic drums, for which it is necessary to install in addition 8 to 12 magnetic drums. These requirements result also from the fact that magnetic drums perform more reliably than magnetic tape. In connection with the fact that it is impossible to completely eliminate magnetic tapes from use, it is desirable that their quality be better.

In some computing centers attempts have been made to use four on-line storage units. This makes it possible to speed up the sorting of information and to combine a great number of steps on a single computer.

Much has been done in order to improve programs themselves. However, only those changes are effective in improving programs which produce a gain in time of not less than 10 to 15 percent. Only under this condition is the time spent on their testing and introduction to be recovered later. For seven years now the "Operating Day" program has been used and for all seven years changes have been made in it constantly, because of which it has in no way been able to proceed to the "working stage" but has all the time been at the testing stage, as the result of which it is very difficult to work with it.

Of course, a major objective of the computing center is the timely production of developments for Gosbank institutions. Obviously, the testing and introduction of new developments to the detriment of timeliness in completion of the daily data processing cycle is impermissible. Taking this into account, we consider it necessary to observe two major requirements relating to new developments. First,

their feasibility must be evaluated not by itself but in relation to inevitable changes in the general technological process of data processing, i.e., taking into account their influence on the 24-hour cycle. Second, on account of the high level of the development and the strict observance by the developer of certain organizational and special requirements, the testing and introduction of developments must be guaranteed without any additional corrections and accommodations whatsoever.

Operating experience has brought up the problem of issuing new editions of instruction materials on the major problems solved: "Operating Day," "Control of MFO," "Receipting of MFO" and "Pension." It is first advisable to assemble a list of possible error situations for each program from each computing center, since individual error situations do not occur at all centers. After the issuance of new instructions it can be helpful to assemble annually additional lists of newly discovered errors and to develop supplements to the instructions.

Slowly problems are being solved relating to the development of time norms for the solution of problems, advanced know-how in organizing the process of processing information on a computer is being studied, generalized and disseminated, the optimum variant for the computing process production process is being selected and possibilities for some unification of this process are being studied as well.

A great amount of work was done by the computing center on enacting the State Bank's measures relating to fulfillment of the decisions of the 25th CPSU Congress with regard to the mechanization and automation of bank operations. In keeping with the coordination plan of the main computing center, our center was entrusted with the task of developing together with the main computing center a production process algorithm and software for the problem "Payment Transaction Accounting." This problem was developed first in terms of forms of statements and then in terms of the economic content of operations; at the present time information is being put out for industries of the national economy and for enterprises within an industry.

The source of information for payment transaction accounting is monetary settlement documents paid from settlement, current, loan, budget and other accounts and furnished with a "Kind of Operation" requisite supplied on each settlement document in conformity with USSR Gosplan Instruction No 12, as well as with a payment transaction classifier.

A financial transaction report reflects the structure of payments and the receipt of money, including personal income and expenditures, in terms of the economic content of operations and is in the form of a breakdown based on personal payment transaction accounts which reflect the realization, distribution and redistribution of the cost of the social product and national income and the structure of payments and the receipt of money and are supplemented by indicators characterizing changes in credit investment and money balances on settlement and current accounts per month.

At the present time the office's computing center, for the task "Payment Transaction Accounting," draws up and issues every 10 days and upon the expiration of a month, to the economic planning department of the office and to Gosbank institutions in Gor'kiy, a payment transaction breakdown in terms of the economic content of operations for industries of the national economy per Gosbank institution and for the

city as a whole; personal payment transaction accounts by forms of statement for Gosbank institutions in the city per industry of the national economy; and personal payment transaction accounts by the economic content of operations per fiscal agency. In addition, every month tables are drawn up of changes in credit investments and money balances in statement, current and other accounts per each institution and for all Gosbank institutions as a whole in the city.

Information issued by the computing center on payment transactions has been fully developed in the office's economic planning department. Special "Payment Transaction Analysis" analytical tables are drawn up individually for the economic content of operations and forms of statement. At the expiration of a 10-day period and month analytical tables and movement sequences are brought to the performer (the Gosbank institution) where a determination is made of the percentages of individual forms of settlement per 10-day period.

On the basis of this information a real-time check is made of the pace of production and of the realization of products and services and of the structure and dynamics of money turnover.

The problem which has been implemented together with the economic planning department are constantly being improved for the purpose of achieving more reliable information obtained from the computer.

The data base for payment transaction accounting created at the computing center of the Gorkovskaya office has promoted the development of new forms of analyzing payment transactions. Computing center specialists at the Voronezh office, upon assignment from the main computing center, have developed a program for obtaining information on financial transactions in the context of sector departments of the office.

Big changes in the software for this problem have been proposed in connection with the production process algorithm developed by our computing center for the problem "Financial Transaction Accounting with a Reduced Range of Indicators," the main purpose of which is to obtain data which would be used with maximum efficiency by Gosbank institutions in practical work.

The valuable experience gained in developing and implementing the "Payment Transaction Accounting" problem is being used by us in designing the software for the "Financial Transaction Control" subsystem for YeS [Unified Series] computers for an experimental area of the USSR Gosbank OASU [Industry Automated Control System], the preparation of which has also been entrusted to our computing center.

The following problem must be solved. During work on the implementation of software the need arose to create a separate group in the computer technology department for software accompaniment, in connection with which the need arose to change the structure of the computing center staff.

In conclusion we would like to make a number of comments and suggestions regarding improving the work of computing centers, aimed at the fuller utilization of computers and the creation of better conditions for computing center personnel. For example, with the continuous growth in the number of Gosbank institutions served and the amount of information to be processed office computing centers are guided

by the "Tentative Instructions for Operation Work, Bookkeeping and Document Circulation for Gosbank Institutions," to which partial changes and additions were made in 1975-1977; but this document all the same does not reflect the changes in accounting and data processing which have occurred in recent times, especially in connection with the introduction of new subproblems and the method of the direct input/output of information in computers through communications channels. Therefore, there is an urgent need to have comprehensive instructional materials on operation work, bookkeeping and document circulation for Gosbank institutions served by computing centers.

Experience has demonstrated that Gosbank institutions, on days when there is a great amount of information and on the last working day of the month, especially, commit errors in the transfer of information, which not infrequently results in the distortion of bookkeeping and statistical reporting. We do not have the right to correct them with last month's figures and we also cannot send out an unreliable breakdown or statistical report. It is advisable, in our opinion, to permit Gosbank institutions to correct erroneous entries during three working days, as a minimum, by means of the usual orders. No small number of difficulties arise in problems relating to furnishing existing computing centers with operating materials and spare parts. The paper supply situation is similar. We are allotted far from an adequate amount of the materials required.

We would like to dwell on one more problem which in our opinion is of no small importance--planning the work of computing centers. Hitherto there has been no exact stipulation of indicators for evaluating the results of their work, and if they do exist then they do not meet the requirements imposed on computing centers.

A unified procedure is necessary for determining the time for data processing, at least for one major problem, "Operating Day." We believe that the input time for this problem should be isolated into an independent indicator and that the total time for solving the problem for all runs, taking into account losses of useful time, should be regarded as the processing time. In this case the time for processing documents for the "Operating Day" problem will reflect with greater reality the level of organization of work on solving this problem and the level of the state of software and of the presence of hardware. In addition, norms should be established for losses resulting from program errors, the lack of hardware and errors made by personnel in running problems.

The present procedure for planning and evaluating the work of computing centers is based on the "wage fund" indicator and indicators for labor productivity and the cost of work performed are computed from this figure. However, this procedure does not interest a computing center in increasing its volume of work, for the smaller the volume of work the lower are costs and the lower the need for people, because of which greater wage fund savings are created in these centers than in centers in which almost all the staff positions are filled.

In recent years the trend has been observed of a turnover in personnel in such fields of specialization as electronic engineering and software engineering. This category of worker is leaving the Gosbank system for other sectors of the national economy chiefly because of the complex working conditions. In Gor'kiy many computing centers work one or a maximum of 1.5 shifts. But as far as working conditions for us are concerned, the data processing process is organized in three

shifts and the second and third shifts have a greater load than the first. It is impossible to change the production process since the transfer of information from Gosbank institutions is completed no earlier than 1700 h and on individual days even later. The work is completed at Gosbank institutions after completion of the transfer of information to the computing center, but the center is just beginning at this time its main job of solving problems and sometimes completes it far after midnight. In connection with this it is necessary to take all necessary measures to create normal conditions for center personnel.

The teams of the Gosbank oblast office, computing center and divisions in Gorkovskaya Oblast, inspired by the decisions of the 26th CPSU Congress, have assumed heightened socialist obligations and are full of resolve to devote all their knowledge, know-how and efforts to assist in every way the fulfillment by sectors of the national economy of the objectives of the 11th Five-Year Plan.

8831
CSO: 1863/29

EXPERIENCE IN AUTOMATING PLANNING AND FINANCING OF SCIENTIFIC-RESEARCH AND EXPERIMENTAL DESIGN WORK IN SCIENTIFIC RESEARCH INSTITUTES

Moscow FINANSY SSSR in Russian No 9, Sep 81 pp 45-49

[Article by G. L. Bromberg, sector chief, All-Union Scientific Research Institute of Optical-Physical Measurements, candidate of economic sciences, and E. I. Zuyeva, chief engineer of the institute]

[Text] In the resolution of the CPSU Central Committee and the USSR Council of Ministers dated 12 July 1979 very serious attention is given to improving the control of branch science. In particular, to accelerate scientific and technological progress and expand the output of our highly efficient production it is proposed to complete in 1980 the transition of our scientific-research, design and technological organizations to khozraschet organization of work on the creation, organization and introduction of new technology.

The introduction of khozraschet assumes primarily improvement of the system of planning and financial calculations in scientific-research institutes and design offices necessary for objective estimation of the cost of each complex scientific-research program. This fact, as practice has shown, sharply increases the volume of information with which the scales of financial reserves for branch organizations are determined. The information in turn requires large efforts on its processing, efforts repetitious and very monotonous. Under these conditions, automation of financial data processing becomes an important task of the day.

In solving this difficult task some help can be obtained from experience of the largest metrological institute, which has developed and introduced the automated system for management of scientific-research and experimental-design work (ASU-NII).

The main goal of ASU-NII introduction consists in improving management of the activity of a scientific-research organization, assuring a very rational distribution and use of financial resources and the effective obtaining of data within the times necessary for optimum management. To do this, in the developed automated system for planning, reporting and monitoring the course of scientific-research and experimental-design work for a large scientific-research institute with many users and a varied set of themes, six complexes of tasks are being solved on computers. First: formulation of thematic plans of subdivisions of the scientific-research institute according to network models; second: determination of the cost characteristics of the plans for loading the subdivisions; third: determination of the most advisable distribution of financial resources in the scientific-research institute; fourth:

forecasting the financial state of the scientific research institute; fifth: effective monitoring of the execution of thematic plans, reporting and quantitative analysis of the executed nomenclature of work; sixth: reporting and analysis of the fulfilling of the cost indicators of plans of the subdivisions and institute as a whole. Each complex includes several tasks.

The basis of the functioning of the system is network plan-schedules by themes. These are graphic representations of a network model of a complex of elementary work which can be designated for organization of the performance of specific scientific-research and experimental-design work. They permit depicting a complex of work on each scientific problem in all its complexity, correctly determining the size of the critical path, scientifically substantiating the length of research and the volume of the necessary financial resources, establishing the connection between work units, their sequence and interdependence and implementing continuous monitoring of the course of the development.

In the existing system qualified specialists--managers of subdivisions which determine the main parameters of each elementary work and coordinate them with all the co-executives--are drawn in to compile network schedules. The system processes and issues operational information on the course of the work and cases of deviation from the plan. It is constructed with the following requirements taken into consideration: the number of themes to be developed in the period being planned; network schedules have been developed for all themes; the manpower and financial resources are constant in the course of the period under consideration.

Network schedules are compiled for each separate item of scientific-research or experimental-design work in accordance with "Principal positions on the development and application of a system of network planning and control" [1]. The degree of specification of the schedule can be different and must assure efficient monitoring of the course of work for the unconditional attainment of the final goal. Schedules are prepared for the principal fragments presented by the executive-subdivisions participating in the development. In the development period all questions connected with the conditions and periods set for performance of the work are agreed upon between the subdivisions.

The information circulating in the system is coded. Codes, lists and classifiers have been developed for this purpose, representing summaries of concepts, names and their codes in the form of numbers or letters.

The main information for each network schedule is: a five-symbol order code, a two-symbol code of elementary work items, the number of the events concluding the work and codes of documents serving as the basis for executing or modifying the work and approving its execution.

The order codes characterize either the year of conclusion of the contract for economic work or the year of opening of an order financed from a centralized fund of a ministry or budget (one symbol), the ordinal number of the economic contract (or order) and the year of its opening (three symbols); the last digit of the code (from 0 to 9) is the number of the network schedule compiled for the specific instrument or theoretical development.

The number of stages and events characterizes their sequence according to the network schedule (00-99); the numeration of the events of each subdivision starts with 01. Each elementary work unit has a digital two-symbol code. It is set in accordance with the classifier of elementary work units, created in the institute in accordance with the existing system of coding designer documentation. For example, the development of a technical task--01; the compilation, coordination and approval of a contract--02; the conducting of theoretical research--08.

In addition, subdivisions and themes are coded. All subdivisions have a digit. Themes are allocated a five-symbol digital code, the first digit of which is the problem number, the second the type of work (scientific-research or experimental-design), the third the year of opening of the theme and the last two--its ordinal number in the year.

The completion of each work unit is attested to by special documentation regulated by standards of the enterprise, in order to be able to verify the correctness of completion in essence. These documents are also coded in the system. For example, the report on closing a stage in the work--01; the invoice covering transfer of an instrument to the buyer--08; the report on technical inspection--09; an explanatory note for drawings--14; textual documentation for an instrument--16.

On the basis of network schedules a file of starting data is compiled on especially developed forms. The starting data is fed into a computer and the network topology is verified, and the quarterly thematic plans and changes and supplements are formulated according to programs.

The network topology must be verified because the network schedules at a large institute include, as a rule, several hundred, and at times more than 1000 elementary work units and it is impossible to establish the correctness of connections between them manually. On the computer random or logical errors are sought which lead to blind alleys or circuits which ought not to be present in a network schedule. The blind alleys are determined according to program, that is, the events from which not a single work unit emerges, only if those events are not concluding for the given network (blind alleys of the first kind), or events which include not a single work item, only if those events are not initial for the given network (blind alleys of the second kind). The network schedule there must not be closed circuits, that is, paths connecting certain events with themselves. Search for blind alleys and circuits constitute the content of the network topology verification--the first task of the first complex of the system under consideration.

Verification of the network schedule topology is not the only verification of purity of the starting data. In solving tasks of the first complex in the system, a verification is also made by computer of the correspondence of the times of completion of the planned stage work by directive documents, which is especially important for complex scientific programs, and also the correctness of compilation of the list of executive-subdivisions. When errors are detected the corresponding signals are issued.

The system, as already mentioned, forms the characteristics of network schedules, thematic plans and supplements to them and makes corrections to plans. On the thematic level, elementary work units are characterized by names, events (initial and final) for each work unit, the state of work in the current quarter and also the digits of documents attesting to completion of work (see Table 1).

Table 1
Form No (quarterly)

THEMATIC PLAN OF SCIENTIFIC RESEARCH AND EXPERIMENTAL DESIGN WORK BY SUBDIVISION ______
(subdivision number)

FOR QUARTER 4, 1980

Stage Number*	Name of stage ard elementary work	State of work in current quarter	Event: initial	Event: final	Plan date: start	Plan date: conclusion	Document attesting to completion of work
1	2	3	4	5	6	7	8
050	Investigation of radiometers and devices to test them	continuation	04	05	291279	300581	01
060	Certification of radiometers and devices for radiometer calibration	start	16	17	311280	300981	01
04B	Author's inspection of manufacture of subassemblies of calibration device	conclusion	15	16	290680	311280	01
04B	Installation and adjustment	conclusion	15	26	290680	311280	16
050	Making prototype of device for measuring smoothness of materials	continuation	36	37	290680	280281	09
040	Certification of metrological device and transmission to buyer	continuation	11	14	280980	310381	08
040	Preparation of textual documentation and transmission to buyer	continuation	11	15	280980	310381	14
040	Execution of work in 4th stage	continuation	12	13	280980	310381	01

*The first two columns are assigned under the code of the order and theme

Chief of planning section

_____, 1980 (signature)

Date of report

Chief of subdivision

Approved

To solve complexes of tasks in planning the financial resources of scientific-research organizations (the second and third complex) the following must be entered in the computer: all the cost parameters of each contract (or order), specified by stages and quarters of the planning year, executive-subdivision and elements of expenses; the periods of effect of each contract (or order) and of doing the work by stages; the terms of payment between buyer organizations and contractors; incidental work (periods, cost and results--manufactured material values or documents of scientific-research work); the plan wage fund by subdivisions; plan calculation with a breakdown by stages and by organizations on the whole for the year.

On the basis of the listed indicators and the ASU-NII a starting data file is formed using the developed forms and is entered in the computer.

Information is received and entered in the data bases on the basis of an automatic monitor present in the ASU-NII system, one which permits determining the correctness of the adopted requisites with respect to the number of symbols and completeness. In the process of reception of the starting information, moreover, logical monitoring of the correspondence of interconnected plan indicators is accomplished: the cost of stages of the work and the total cost of the order (theme), the distribution of cost indicators by subdivisions and periods. If errors are detected the corresponding signals are issued. Plans of subdivision expenditures are formulated on the basis of the listed information according to program.

This document characterizes expenditures of subdivisions for each quarter of the planned year for all orders and elements of plan calculation and contains a plan for transfer of work by months. Like the thematic plan it is approved by the director of the institute. The expenditures plan, determining the financial indicators of the work, in practice intensifies the responsibility of the subdivisions for the observance of plan discipline and serves as a means of monitoring their activity by means of the ruble. It is prepared quarterly and as required, that is, in cases where plans are examined or the executives or orders are changed.

In addition, plan calculations are formed in the system, with a breakdown by elements of expenditures, for the institute, subdivisions and themes for the year and the quarter, and also inquiries about the size of the planned profit. These forms are intended for bringing expenditures into correspondence with the approved volume of financial resources, for the effective development of measures to put in order the loading of subdivisions, the redistribution of resources among them and calculation of the amount of profit.

The redistribution of means of production is made by multiple calculations on the basis of determinable loading coefficients of each enterprise. The latter is calculated as the ratio of the sum of wages of subdivision workers on all contracts (orders) in the planned year to its annual planned fund.

As practice has shown, the most advisable boundary values of that coefficient must not exceed 1.1 or be smaller than 1. In addition, the total sum of expenditures of all subdivisions is compared item by item with the estimate of expenditures of the institute. Then the coefficient is calculated which shows the total volume of expenditure per ruble of the planned wage fund for each subdivision. If lack of correspondence is found, measures are taken to redistribute the expenditures. In those cases the starting information is corrected and a recalculation is made to use the resources better than in the original variant.

Table 2
Form No

Forecast of the Financial State for 1980

Номер этапа*	Сумма аванса	Sum of Arrivals of Resources by Months of the Year (1000 rubles)												Всего за год
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
020	9,0	9,0		22,1										31,1
030								11,2						11,2
010	8,1				8,1			8,1						16,2
02A	25,9							25,9		25,9				51,8
010		45,4												45,4
020	138,6	138,6				138,6								277,2
010	52,0						52,0						52,0	104,0
010	30,4	30,4						5,2						35,6
020											20,1			20,1
020	26,9	26,9	27,5											54,4
030									39,1					39,1
010	5,4													
020	23,6	23,6							35,3					58,9
010	28,9	28,9				5,8								34,7
020							5,7							5,7
030							13,0			19,4				13,0
040												17,1		19,4
050														17,1
010	12,4	12,4						68,4						80,8
010	29,6	29,6											29,6	59,2
016	75,0	75,0							85,0					160,0
01A					109,4									109,4
010	32,3	32,3						49,1						81,4
010	35,9	35,9			20,6									56,5
etc	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	626,9	575,3	27,5	22,1	138,1	153,4	97,2	175,6	253,1	93,2	25,7	17,1	218,6	1796,9

1 -- Stage number*
2 -- Sum of advance

15 -- Total for year

*The first three columns are assigned under the code of the orders, numbers of the main subdivisions and number of purchaser-organizations.

The profit is calculated by themes (orders) with an estimated cost of not more than half the economic effect guaranteed by the developer, formed at the purchaser-organization upon introduction of the scientic-research or experimental-design work into production. It is calculated at the rate of 1.5 percent of the calculated economic effect attested to by the purchaser, but not more than 6 percent of the estimated cost of the work. These principles were made the basis of an algorithm for solving the task of determining the size of planned profit by theme and verifying the correctness of the calculation of its value for the organization as a whole.

An important task solvable in the system is "Forecast of the financial state of the institute." Here determinations are made of the sums and dates of arrival of resources by months at the account of the institute. The following indicators

participated in the solution of the task: theme (order) code; periods for doing work and their cost in the planned year; the percentage of the advance of buyers payable upon conclusion of the contract, and conditions of payment with respect to advances.

The algorithm for work of the program on formation of a forecast of the financial position consists in determining the sum of arrivals by completed stages of the work and advances of purchasers by months of the planned year. The costs of stages being completed and the sums of advances obtained at the start of the planned year or the first stage of work are selected from the computer information data bank for that purpose. In calculating the sum of arrivals the subsequent record of advances and time necessary for the turnover of documents on formulation of the conclusion of the stage receives attention. Provision is made on the form for determination of the sums of arrivals during the year by orders (stages) and the total for each month of the year (see Table 2). The forecast makes it possible to determine the stability of the financial state of the institute and adopt measures in time to redistribute the resources over the course of time.

The monitoring of the execution of thematic plans was constructed in the following manner. Reports on the course of the work (start, conclusion and stoppages) arrive in the computer center over the telephone daily from the subdivisions. The data are entered in a special journal and twice a week a report is made on a computer in which the plan and the actual execution are compared for each elementary work unit. When necessary, signals regarding cases of deviations from the planned tasks are formed in the computer. On the basis of the obtained information, decisions are made regarding elimination of the deviations. If necessary, files are prepared for the correction of thematic plans and the correction itself is made.

At the end of the quarter, on the basis of a computer analysis, reports on the fulfilment of the quarter plan are composed. They are formulated by subdivisions which have and have not successfully coped with the plan. Simultaneously a quantitative analysis of the execution of the work list by subdivisions is made on the computer. The total number of orders filled by a subdivision in the report quarter is determined, including the especially important orders; also the number of orders filled on time, ahead of schedule and with delay; the number of plan corrections made (and of them, those occurring through the fault of the subdivision) and of reports on the course of the work not issued in time. Such an analysis permits evaluating the execution of the thematic plan by a subdivision.

At the end of the quarter each subdivision sends to the computer center reports on the execution of the plans for expenditures on elements of plan calculation. In addition, the accounting office monthly transmits reports on the actual expenditures on orders. The information is entered in the computer and then the reported and plan indicators are compared.

In the computer solution of tasks, reports are compiled on deviations from the planned expenditures on subdivisions and themes and on elements of the plan calculation. Such reports help to efficiently redistribute financial resources among themes. A report also is compiled on the cost of scientific-research and experimental-design work; it reports on planned and actual expenditures on each order and theme from the start of the work. The information is accumulated and summed by

themes and institutes, and the possibility of saving resources and obtaining an actual profit is established. On the basis of this form a statistical report is compiled and decisions are made on the correction of expenditures.

The organizational and functional structure of the entire automated system for planning and monitoring the course of scientific-research and experimental-design work on the whole can be represented in the form of a number of stages.

1. The subdivisions of the institute and the planning service prepare starting data on the elementary work of the network schedule and the cost parameters of the theme. 2. The starting data are entered in the computer. 3. Program monitoring of the starting data and monitoring reports on the checking of the network schedule topology and the cost indicators are printed. 4. When a lack of correspondence is detected between individual parts or plan indicators the starting data are returned for modification. 5. In the absence of lack of correspondences the planning calculations are made on the computer and output reports are printed which are directed toward the implementation and monitoring of the correctness of compilation of the plan. 6. The planning service of the institute, having received the output reports, makes control decisions to issue the planning calculations or do them again on the computer if the loading coefficient is more than 1.1 or less than 1 or in case of non-coincidence of expenditures with the set volume of financial resources. 7. The subdivisions of the institute compile reports on the course of the elementary work and the implementation of the expenditure plans. 8. The reports are transmitted to the computer center and entered in the computer. 9. The report data are compared with the plan data on a computer and the output reports are printed, directed toward the planning service of the institute. 10. On the basis of the reports the planning service checks the execution of the thematic plans of subdivisions, estimates their quality and adopts control decisions on the redistribution of financial resources in the process of scientific-research and experimental-design work.

The set of programs assuring solution of ASU-NII tasks on the YeS-1022 computer consists of six problem-oriented packages of applied programs; each realizes part of a single algorithm of the system. The packages are tehnologically interrelated.

The introduction of the ASU-NII into metrology has permitted, besides detailed planning and efficient management of the course of scientific-research and experimental-design work in the institute, predicting its financial state, determining in time the need and dimensions of the redistribution of financial resources in order to optimize them, determining the size of profit, regulating the loading of subdivisions and effectively obtaining the reference and report materials necessary for managing the course of scientific-research and experimental-design work.

The calculations made at the largest metrological institute have shown that the coefficient of economic effectiveness resulting from the introduction of such a system is more than 3 times as large as the normative and the investment repayment period is a little more than 1 year. Experience in the introduction of the ASU-NII in metrology has shown that it can be completely used by scientific-research organizations of other branches of industry which use the system of network planning. The ASU-NII makes it possible to rationally manage financial resources.

BIBLIOGRAPHY

1. "Mezhotraslevyye, instruktivno-metodicheskiye materialy, utverzhdennyye postanovleniyem Goskomiteta po nauke i tekhnike SSSR" ["Interbranch Instructive and Methodical Materials Approved by the USSR State Committee for Science and Technology"]. Moscow, Ekonomika, 1974.

2174
CSO: 1863/25

BRIEFS

ELEKTRONIKA BZ-24G MINICALCULATOR--Electronic technology has become a firm part of modern life. Minicalculators occupy an ever more significant place not only in complex mathematical calculations but in every day life as well. The bookkeeper calculates wages, the student is involved in calculations and the salesperson calculates the cost of goods. The Elektronika BZ-24G minicalculator will assist all of them. It is held in the palm, has a bright colored keyboard and carries out any arithmetic operations, including those with automatic storage of the result of calculations with overflow. To continue the calculations, it is sufficient to multiply the result by 10 to the eighth power. One can acquire the minicalculator in stores of Kul'ttorg [Organization for Trade in Goods for Cultural Purposes] and of potrebkooperatsii [Consumers' cooperatives]. The price is 40 rubles. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 31, Jul 81 p 23] 6521

INTERNATIONAL COMPUTER NETWORK--The message was entered from afar into the memory of the computer installed at the Moscow Scientific Research Institute of Problems of Organization and Control. The data first came to the computer from the Institute of Engineering Cybernetics, Ukrainian SSR Academy of Sciences, located in Kiev. An international computer network seemed until recently a matter of the remote future. But the first experimental network is already operating in which the computers of Moscow, Kiev and Riga have been connected. They are connected to each other through telephone channels. One can easily and rapidly obtain the necessary information from a computer center operating in another city or on the contrary can transmit required data there by using this complex. And users who do not have their own computers will be able to be connected to this network in the future. Having transmitted a request, they receive data on the display screen or teletype. There is no doubt of the prospects of this system. It would lead to conversion to an essentially new stage in design and operation of collective-use computer centers. Introduction of international telephone channels connecting the computers will significantly increase the efficiency of using the computers, will expand the capabilities of automated management of various sectors of the national economy and will principally alter the technology of information exchange among enterprises, organizations and agencies. And for the present a unique test area of the system is operating. The computers of the capitals of three republics "talk" by telephone. [Text] [Moscow MOSKOVSKAYA PRAVDA in Russian 16 Jun 81 p 3] 6521

COMPUTERS IN CENTRAL HEATING NETWORK--Experimental operation of a section equipped with ASU [Automated control system] has begun in one of the rayons of the Moscow

central heating system. Data obtained from hundreds of sensors installed at different points of the run are fed to a computer. There they are processed and come to the duty dispatcher. Whereas earlier if hours or even days passed before data was received about the operation of the heating route, damage on the line can now be detected within minutes due to the ASU. If an emergency situation or any deviations from the given conditions occur, the computer itself, upon a signal of the sensors, prints out an alarm message and indicates the nature of the deviations. [Text] [Moscow KOMSOMOL'SKAYA PRAVDA in Russian 24 Sep 81 p 4] 6521

COMPUTERS AT VAZ--The process flow diagram of the Volga Automotive Plant has been organized like an electronic clock: three of the latest vehicles come off the main conveyor every minute. But if a part or production assembly is delayed at any point, an interruption of the conveyor rhythm is inevitable. All these extensive facilities of the enterprise, which number tens of thousands of production operations, can now be controlled by computer equipment alone. Our domestic computers and those developed by specialists of CEMA countries will replace the obsolescent models of foreign computers. Among them should be named the YeS-1055, the Robotron and the SM-4. The computer center of the Volga Automotive Plant is a vast, light-filled hall. Spools with magnetic tapes spin noiselessly behind the glass of the computer cabinets and the displays blink with green light. The mark of the American firm General Electric stands on the greater part of the operating computers. And here near the entrance to the room are unpacked boxes of computers with the mark "Made in the USSR." "Connecting all the main production of the association to a real-time ASU [Automated control system]" a Dobryazhskiy said in conclusion, "will be completed by 1983. Introduction of the ASU will denote a new phase in development of AvtoVAZ: all the main production processes will be transferred to the control and monitoring of programmed controllers, minicomputers and displays." [Excerpts] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 4 Jun 81 p 2] 6521

COMPUTERS IN ACCOUNTING--The periods of processing bookkeeping documents have been accelerated by two days at the Magnitogorsk Metallurgical Combine. Putting the YeS-1022 computer into operation helped in this. This is the first third-generation computer at the enterprise that has been installed to replace obsolescent machines. Labor expenditures have been reduced significantly and the volume of work performed by the information-computer center has increased with its assimilation. It is planned to introduce yet another new computer at the combine in the near future. The information-computer work here will be trusted completely to electronic equipment when it is started up. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Aug 81 p 2] 6521

COMPUTER PROGRAM AT GOI--As reported by the Leningrad branch of TASS, a new program entered by colleagues of the State Optical Institute into a powerful computer has made it possible to reduce the time of complex mathematical calculations by a factor of 10. "The Institute is the main scientific center of the sector where future optical systems are first 'calculated' on paper," says the director of GOI, Hero of Socialist Labor M. M. Miroshnikov. "Therefore, although the computer operates for us without days off and holidays, the line of scientists and designers waiting to 'consult' with the machine will never end. Until now the computer could carry on a dialogue with only one person. The workers of our information-computer center have now 'taught' it to converse simultaneously with several persons. Our

specialists learned that a machine 'thinks' much faster than a human and while one of its interlocutors 'processes' the answer just received, another enters his own question at this time. Moreover, the computer 'remembers' about what it was conversing with each of them." Multichannel communications with a 'electronic brain' helped the scientists and designers to appreciably reduce the overall periods of development of innovations. On the average they are four months lower than the norms. [Text] [Leningrad LENINGRADSKAYA PRAVDA in Russian 18 Aug 81 p 4] 6521

LASERS IN HIGHWAY CONSTRUCTION--Developing the complex of equipment for entry of drawings, figures and diagrams into a computer, scientists of the Khar'kov Highway Institute took on a laser as an assistant. A three-dimensional image can be quickly and erroneously translated into the language of numbers coming into the computer when it is in operation. "The mass use of computer equipment required devices which quickly entered graphical information into the computer," said the Head of the Chair of Automatics, Professor V. Tyrsa. "Special codes developed for this are usually complicated and require very exhausting labor from the operator. The use of a laser in combination with a computer considerably simplified the problem." [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Sep 81 p 2] 6521

YES-1055 COMPUTER AT KAMAZ--The new YeS-1055 computer, produced by the Dresden Robotron Combine, has been sent to the Kama Automotive Plant. This is already the 27th device of this type delivered by the enterprise to the Soviet Union since the beginning of this year. Specialists call computers of this type, serial production of which was begun during the previous five-year plan, μ-generation equipment: they are capable of performing up to 480,000 operations per second and are not inferior to the best international models in their efficiency. These computers are the baseline machines in the Unified Computer System of CEMA member countries. It is no accident that their production was entrusted to Robotron. The flagship of the electronic industry of the GDR has a powerful production and scientific research base. A computer-calculator is now produced at the combine every 13 hours. [Text] [Kazan' SOVETSKAYA TATARIYA in Russian 14 Jul 81 p 3] 6521

COMPUTERS IN INSTRUMENT BUILDING AND AUTOMATION--Development and organization of production, primarily of new standardized, unitized complexes based on a single state system of instruments and means of automation, will ensure introduction of the latest advances of microelectronics, optoelectronics and laser technology. Manufacture of more than 2,000 new articles must be assimilated. An important task is to develop a number of standard control complexes based on small computers of the CM EVM [International small computer system] series of the second unit with 5-6-fold productivity and with materials consumption less by a factor of 2-2.5. Not all problems of improving computer production are now solved by Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems]. The reliability and operational indicators of the equipment produced must be increased. Providing the computers with peripheral equipment remains a weak point. Output of it during the period 1981-1985 should be increased 2.5-fold and primarily at the Vinnitsy Terminal Plant, the Orel Computer Plant and the Smolensk Production Association Iskra. Development and organization of production of more than 10 models of computer complexes based on the SM EVM and approximately 100 types of peripheral equipment for them, including input-output devices, storage devices and information display devices, are planned. [Excerpt] [Moscow EKONOMICHESKAYA GAZETA in Russian No 34, Aug 81 p 2] 6521

HARDWARE EQUIPMENT IN ASU--The developers of ASU [Automated control system] frequently orient customer enterprises to a minimum of hardware. I do not feel that this approach is rational. Manufacture, outfitting and delivery, for example, of peripheral devices for a computer, should proceed parallel with development and introduction of ASU systems, as is generally done in manufacture of complex engineering systems. The computer manufacturing plant is obligated to provide a complete set of peripheral equipment in the ASU design rather than adapt the ASU to minimum hardware. Only then will there be order in the engineering part of introducing ASU systems. Moreover, providing the complete set can proceed only as long as required for complete development of the system rather than for 1-2 years. One can no longer talk about minimum hardware upon conversion from ASUP [Automated production control system] to ASUTP [Automated production process control system] since the volume of information will increase significantly and the ASU will be incapable of processing it. When designing an ASU, they now frequently proceed with part of the information rather than from the total volume of information. This approach is one of the reasons for the still low efficiency of computer and ASU use. [Text] [Novosibirsk EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian No 7, Jul 81 p 104] 6521

CSO: 1863/1

CONFERENCES AND EXHIBITIONS

STATEMENTS BY CHIEF DESIGNERS OF SM COMPUTERS

Tbilisi ZARYA VOSTOKA in Russian 12 Jul 81 p 3

[Article by A. Mgaladze, correspondent]

[Text] The 16th session of the Council of Chief Designers of SM Computers of CEMA Member-Countries has been concluded in Tbilisi. Participating in it were specialists in the area of computer technology from the People's Republic of Bulgaria, the Hungarian People's Republic, the GDR, the Polish People's Republic, the Republic of Cuba, the Socialist Republic of Romania and the CSSR.

Statement by B. Naumov, chairman of the session, General Designer of SM Computers, corresponding member of the USSR Academy of Sciences, director of the Institute of Electronic Control Systems:

"In Tbilisi the leading specialists in the development and production of computer hardware have discussed the further paths of development and applications of new productive and economical small computers. Their development and series organization, as was emphasized at the 26th CPSU Congress, opens up wide possibilities for the introduction of systems for the automation of data processing and control not only in the traditional but also in new areas of application of computer hardware.

"Solution of problems in the qualitative improvement of the structure of computer complexes and the development of the elementary base and the design and technological bases are expected to assure the large-series production of SM computers. Oriented toward a broad spectrum of applications, that system will become accessible to a large number of users.

"At the session reports were heard on the concept of creating control computers with the use of microprocessors and large-scale integrated circuits for the creation of the small computer system, and their combination into various network configurations.

"Much attention was given to the effective use of SM computers and sharp expansion of the spheres of automation in various areas of human activity, and also to the development of the electronic base, and especially of microprocessors, sets of large-scale integrated circuits and superlarge-scale integrated circuits, and the effective use of the scientific and technical potential of the CEMA member-countries.

"An important aspect was the discussion of questions of software connected not only with the development and use of software but also with its production."

Statement by N. Gogava, chairman of the organizing committee, chief of the Tbilisi administration of "Soyuzspetsavtomatika":

"This session, at which the further long-term development and use of SM computers was designated, is above all extremely important and useful for those organizations whose themes of work are connected with the development and applications of computer technology in the national economy. Attention was therefore stressed on the possibilities of the practical use of computer technology. In this sense it is gratifying that there was very active participation in the work of the session by the leaders of organizations of the republic--the "Elva" Scientific and Production Association, the process control computer plant, the "Soyuzspetsavtomatika" administration, the "Analitpribor" Scientific and Production Association, and others.

"The basic achievements and advantages of the SM computers is above all their low cost, a single design and element base and compactness. Minicomputers car be effectively used in systems for the monitoring and control of technological processes, in the management of shops and enterprises and to solve technical-economic and dispatcher tasks."

Statement by S. Hausman, chief of the small computer system of the Hungarian People's Republic:

"The session represented a stage in itself. We are proceeding to the development of a third line of the small computers system. The session determined which systems will be produced in the given Five-Year Plan and examined the prospects of development of the small computer system to the year 1990."

Statement by M. Lauermann, division chief of the "Robotron" Association:

"Before proceeding to create the third line of the small computer system it was necessary to determine, as they say, the strong and weak aspects of the two preceding series. We in the GDR have made an extensive analysis of the merits and shortcomings and have designated the main directions of their further improvement. We are working to reduce by half the expenditures of metal and electric power in our articles. Serious attention was devoted to these questions at the session.

"It also rendered assistance in working out the times of tests and introduction."

2174
CSO: 1863/12

EAST GERMAN COMPUTER EQUIPMENT IN MINSK

Minsk PROMYSHLENNOST' BELORUSSII in Russian No 7, Jul 81 pp 53-55

[Article by D. Mikhaylov]

[Text The exhibition "East German Computer Equipment" was recently held in Minsk. It aroused great interest among specialists both in the republic and beyond its borders. The latest advances of the Robotron Company, well known throughout the world by its success in the field of computer equipment production, were demonstrated at the exhibition.

The company combines 19 specialized enterprises at which 70,000 persons work and concentrates in one organization the production of the entire range of East German organizational and computer equipment--from Erika typewriters to large computers of type YeS [Unified computer system]. Robotron devotes special attention to marketing its products in the USSR, which is the largest foreign trade partner of this company. It annually sends thousands of invoice and billing and other computers to our country.

The Robotron Company demonstrated the Robotron 1355 electronic bookkeeping machine and the small Robotron 1711 automatic billing machine at the exhibition in Minsk. These compact desk machines replaced the popular, but already obsolescent models Askota and Zoemtron.

The Robotron 1720 and Robotron 1840 automatic electronic billing-bookkeeping machines--multipurpose devices, which permit efficient solution of such problems as accounting for materials in warehouses, calculation of wages, conducting monetary operations at savings banks and so on--offer great opportunities to the customer. The capability of reading information from special cards with a magnetic strip is provided in these devices, which greatly facilitates printing of accounting documents and management of universal cards. The information required for further processing can also be entered on punch tape or a floppy magnetic disk.

Belorussian specialists related their successful experience of using the Robotron 1840 to account for spare parts in warehouses of Belsel'khoztekhnika, where 120 of these automatic machines have already been installed, at a symposium conducted by the company within the exhibition.

Equipment of the next generation, which will replace automatic billing-bookkeeping machines during the next few years, was also shown at the same exhibition. The German specialists call these devices office computers. The appearance of these desk computers accessible to any accountant or planner is related to progress in the field of electronic equipment and development of so-called microprocessors.

The Robotron Company developed and has already begun production of a number of office computers within the program of the international small computer system (SM EVM), on implementation of which the USSR, East Germany and other CEMA member countries are working. Minicomputers of type SM 1617, SM 6907, SM 6908 and SM 1630 can be used for autonomous data processing at small and medium enterprises or can emerge as remote links of complex computer systems with large central computer. As the Robotron specialists emphasized, Soviet specialists in microelectronics rendered invaluable assistance to them in developing the new electronic circuits of this generation of machines.

Visitors to the exhibition also learned about the advances of Robotron in large computer production. These are primarily one of the most productive machines in the unified series of computers of the CEMA member countries--the YeS 1055 and its improved model, the YeS 1055M. It is sufficient to say that the internal storage of these machines can handle from 2 to 4 million information symbols and the so-called "virtual memory" can handle 16 million symbols, while their external storage is designed for connection of several magnetic disks with capacity of 29 or 100 million symbols each.

This display of the exhibition began to operate permanently in Minsk long before its opening--the 25th copy of a computer of type YeS 1055 delivered to the USSR was formally turned over to the Scientific Production Association Niva by the company.

The characteristic feature of the engineering policy of Robotron is that the company offers its partners not only the computer equipment itself, but also the concepts of using it, the necessary systems and applied programs and organizes training of speiaalists and maintenance.

6521
CSO: 1863/240

ALL-UNION CONFERENCE ON ORGANIZATION OF MAINTENANCE AND TECHNICAL SERVICING OF COMPUTER EQUIPMENT

Moscow VESTNIK STATISTIKI in Russian No 8, Aug 81 p 71

[Article by V. R. (not further identified), Moscow]

[Text] In April of this year at Orel an All-Union Conference on Oranization of Maintenance and Technical Servicing of Computer Equipment in the system of the USSR Central Statistical Administration (TsSU SSSR) and ways to improve it in the 11th Five-Year Plan was held in which representatives of union and republic main administrations of computation work of the TsSU SSSR participated, and also representatives of Soyuzschettekhnika of the TsSU SSSR.

Opening the conference, the deputy chief of the Main Administration of Computational Work of the TsSU SSSR, V. Ryzhavin, noted that in accordance with the resolutions of the 26th CPSU Congress more attention must be given to the effective use of computer hardware and progressive methods of organizing the maintenance of machines and equipment which assure increase of their working period between repairs.

Questions of improvement of the planning of maintenance of computer hardware, the introduction of centralized technical servicing and improvement of the work of repair plants are constantly at the center of attention of the management of the TsSU SSSR. The reporter further discussed the work of the computer system of the TsSU SSSR in the Tenth Five-Year Plan and dwelt on tasks of the 11th. Those tasks, he said, require increased effectiveness of the work of computer hardware, an indispensable condition of which is a well-organized system of technical servicing and repair of computer hardware.

In 1979 the need for maintenance of the computer hardware of the TsSU SSSR system was 70 percent satisfied, and in 1980 by 92 percent, but the percentage of downtime of equipment increased in 1980. The largest percentage of downtime in the course of several years was on accounting machines.

In the Tenth Five-Year Plan a number of normative documents were prepared, approved and put into effect to put in order the planning of maintenance of computer hardware and increase responsibility for the technical state and qualitative performance of work on technical servicing. However, not every center and station, and also enterprise of Soyuzschettekhnika of TsSU SSSR is carrying out the instructions of those documents. The Main Administration of Computational Work (the Republic Computer Center) of TsSU's of the union republics and also Soyuzschettekhnika of TsSU SSSR

must be more exacting toward the quality of reports on the maintenance of computer equipment.

The participants in the conference were informed thoroughly about the course of the introduction of the provisional draft of the Unified System of Planned Preventive Maintenance of Computer Hardware, and also unsatisfactory maintenance and debugging work of new imported hardware.

In conclusion the reporter noted that it is necessary to more rapidly eliminate defects, introduce centralized technical servicing and improve the quality of maintenance work.

A. Khromov, deputy chief of Soyuzschettekhnika of TsSU SSSR, discussed the results of work of enterprises of that association. Attention was turned, in particular, to difficulties in the introduction of the Unified System of Planned Preventive Maintenance and centralized technical servicing.

Yu. Romanov, deputy chief of the Main Administration of Computational Work of the TsSU RSFSR, G. Dubinskiy, deputy chief of the Tul'skaya Oblast Information-Computer Center of state statistics, V. Burkov, chief engineer of the Computer Center of the Gor'kovskaya Oblast Statistical Administration, etc, spoke about the inadequate quality of centralized technical servicing and of failures of plants to carry out setting-up debugging work and warranty maintenance due to an absence of spare parts and specialists. The "Askota-170" is poorly serviced and maintained due to an absence of spare parts, and the unit method of maintenance is being ineffectively introduced. The technical base of maintenance enterprises is incomplete, and without it it is difficult to introduce the Unified System of Planned Preventive Maintenance.

A. Tomkovich, general director of the Belschettekhnika Production Association, turned special attention to the fact that in the TsSU SSSR old equipment is being used for which there are no spare parts, the question of truck transport should be decided and, in addition, an exchange fund should be organized.

Yu. Stadnik, general director of the Ukrschettekhnika Production Association, dwelt on inadequately substantiated planning of equipment maintenance and on the fact that there should be a more attentive attitude toward the introduction of the Unified System of Planned Preventive Maintenance.

At the conference recommendations were adopted in which the basic tasks were formulated in the improvement of maintenace of equipment, the timely conducting of setting-up debugging work, the introduction of the Unified System of Planned Preventive Maintenance and also centralized technical servicing.

2174
CSO: 1863/12

CONFERENCE ON COMPUTER NETWORKS

Riga SOVETSKAYA LATVIYA in Russian 21 Oct 81 p 3

[Article by LATINFORM correspondent]

[Text] The development of computer networks was named among the most important scientific problems in the resolutions of the 26th CPSU Congress. They must assure the most rational use of the computer pool of the entire country. It is a matter of creating a unified state system of communication between electronic computers which will permit effectively interchanging programs. Practically any information preserved in the data banks of institutions and enterprises will become generally accessible.

An All-Union Conference on Computer Networks, organized by the USSR Academy of Sciences and the Latvian SSR Academy of Sciences, was opened in Riga on 20 October. Participating in it are delegations representing academic and branch scientific institutes, VUZ's and computer centers of various ministries and departments. They include eminent scientists and specialists from Moscow, Leningrad, Novosibirsk, Kiev, Minsk, Vilnius, Tashkent, Alma-Ata, Yerevan, Tbilisi and many other cities of the country. Guests from Hungary, the GDR, Poland and Czechoslovakia also are present.

The forum will last 3 days. At the plenary sessions and in the sections it is proposed to examine a broad range of questions connected with the practice of computer network construction, the development of ways and means of data transmission and control of its flows. About 120 reports will be read and discussed.

2174
CSO: 1863/31

'COMMUNICATIONS-81': INTERNATIONAL EXHIBIT IN MOSCOW

Moscow EKONOMICHESKAYA GAZETA in Russian No 37, Sep 81 p 24

[Article by M. Makhlin]

[Text] "Communications Equipment for Society and Mankind": this is the slogan under which the "Communications-81" international exhibit of communication systems and equipment is being held in Moscow's "Sokol'niki" Park from 2 to 16 September. More than 400 foreign organizations and companies are participating in it.

How Great Distances Are Shortened

There are more than 300 exhibits in the Soviet section. The scope of these exhibits is so broad that it ranges from space satellites and the newest electronic devices to home-made wireless radio instruments and postage stamps.

There are 220 Soviet enterprises and scientific research institutes involved in the formation of the nationwide Unified Automated Communication System. In scale, it has no equal anywhere in the world. The intranational satellite communication system is also unique. Ground station equipment and models of the "Molniya-3," "Ekran" and "Gorizont" satellites are on display at the exhibition. They are used to transmit information, editions of centrally published newspapers and television and radio programs to the most remote parts of the country. The new 24-hour television center that was built for the 1980 Olympics and is still in operation makes it possible for viewers in different areas to see Central Television Network programs at a time convenient for them. The complex of equipment for receiving remote transmissions from an "Ekran" satellite, which is intended for use in small settlements, is compact and comparatively inexpensive (about 15,000 rubles).

A special display is devoted to illustrating our country's participation in the international "Kospas-Sarsat" project. The USSR, together with Canada, the United States and France, is solving the problem of detecting ships and airplanes that are in trouble and determining their coordinates with the help of radio beacons and low-flying satellites. The work being done on organizing the "Inmarsat" international marine satellite communication system is also demonstrated.

On the other hand, there is also a purely terrestrial exhibit: an automated center for the technical operation of an urban telephone station that can handle 300,000-500,000 numbers.

The multiterminal information processing system based on the SM-1800 microcomputer will become a reliable assistant for economists and communication specialists. The expense of introducing it will be recovered in less than 6 months. Why is this? It reduces the time required to process economic information by a factor of more than 10, while the time required to program specific problems is reduced by a factor of 25.

The postal service is also adapting itself to the speeds encountered in the space age. At the exhibition there is a sorting line with a system for recognizing indices on envelopes. Its capacity is 28,000 letters per hour.

Communications equipment carrying the name of Soviet enterprises has earned deserved prestige on the world market. More than 3,000 types of telephone, telegraph and electroacoustic equipment, along with radio and television equipment, are being exported.

Fruitfulness of Joint Efforts

The technology demonstrated by foreign participants in the exhibition is also distinguished by its high technical level. Fruitful collaboration within the framework of CEMA and on the basis of bilateral agreements enriched considerably the exhibits of Bulgaria, Hungary, the GDR, Poland, Czechoslovakia and Yugoslavia.

The "Elektroimpeks" association (People's Republic of Bulgaria) is demonstrating remote repeaters and repeater amplifiers with doubled efficiency. Correspondingly, their need for electricity in order to operate has been halved. The "Budavoks" association (Hungarian People's Republic) is showing original equipment for long-distance telephone and telegraph communication and innovations in radio relay equipment. Teletypes and high-productivity telephone stations are represented in the GDR's exhibit. During the exhibition, a switching technology complex capable of handling 4 million subscribers will be solemnly handed over to Soviet communication experts.

The Polish "Elektrik" association brought new models of telephone equipment to the exhibition, ranging from ultramodern to decorative "old style" pieces, as well as an automatic telephone "operator" that gives subscribers directory information that they need. The "KOVO" association (Czechoslovakian SSR) is acquainting us with high-efficiency, miniaturized electromechanical filters and radio studio equipment. Electronic equipment for automatic telephone exchanges is represented in the exhibit of the "Nikola Tesla" enterprise (Socialist Federated Republic of Yugoslavia).

For Mutual Profit

The exhibition has attracted the attention of many foreign organizations and companies. Our northern neighbors from Denmark, Norway, Finland and Sweden are taking an active part in it.

Among the largest exhibitors is that long-time partner of Soviet foreign trade organizations, the Finnish "Nokia" company and its offshoots. They are showing cable products and telephone exchanges for different purposes that feature microprocessors and even fiber optic systems, where extremely fine glass fibers carry out the functions of wires. The Swedish "Svetsiya" company is acquainting us with

equipment for producing printed-circuit cards for radio engineering use, while the "AGA" company from the same company is displaying infrared equipment. The "Norsk Data" and "Mikron" companies from Norway brought their newest microcomputers to the exhibition, and the Danish "Elektronik," "Elmi" and "Storno" companies are demonstrating electronic measuring equipment for use in communications.

Many original innovations can be seen at the exhibit stands of companies from other countries that are participating in "Communications-81": Austria, Great Britain, Spain, Italy, Canada, Lichtenstein, the Netherlands, the United States, France, the FRG, Switzerland, Japan, and even West Berlin.

Tens of thousands of Muscovites and visitors to our capital visited the exhibition the first few days it was open. The commercial center is already receiving news about the path of negotiations and the conclusion of mutually profitable contracts. A symposium at which 58 reports by Soviet and foreign specialists will be heard has been organized within the framework of "Communications-81." This great international review will undoubtedly serve to strengthen existing and establish new mutually advantageous contacts among the business circles of different countries.

11746
CSO: 1863/8

BRIEF HISTORY OF YEREVAN SCIENTIFIC RESEARCH INSTITUTE OF MATHEMATICAL MACHINES

Yerevan KOMMUNIST in Russian 23 Oct 81 p 2

[Article by M. Semerdzhyan, director of Yerevan Scientific Research Institute of Mathematical Machines (Yerevanskiy nauchno-issledovatel'nyy institut matematicheskikh mashin--YerNIIMM)

[Text] Electronic computer technology is a relatively young direction of science and technology. It was brought to life by a need of the time and at the start of the 1950's was still in the initial stage of its development. It was precisely then that the first electronic computers appeared, and their enormous role and prospects in the scientific and technological revolution proceeding in the world became understandable at once.

In June 1956 the scientific research institute of mathematical machines (YerNIIMM) was organized in Yerevan.

The first director of the new scientific research institute was the well-known scientist, Corresponding Member of the USSR Academy of Sciences S. N. Mergelyan. He displayed great abilities as a scientific organizer in the creation and leadership of the YerNIIMM. In our republic it became possible to develop a new branch, one to a great extent determining for its national economy, mathematical machine-building. Successfully combining scientific with pedagogical activity, it has prepared in Armenia a large number of highly qualified scientific workers and specialists.

In 1961, on the basis of the experimental plant of YerNIIMM, a new industrial enterprise was organized for the production of electronic computers and computer hardware--the "Elektron" plant (now the Armenian Production Association "Elektron").

At the beginning of 1958 the development of two computers, the "Aragats" and the "Yerevan," was started at the YerNIIMM, and somewhat later, the "Perepis'" computer (to process the results of the USSR Census).

The young collective of the institute applied enormous efforts and displayed a maximum of organization. The work was done with great enthusiasm. State tests of the first two computers were successfully completed in May 1960, and a year later the "Perepis'" computer was installed and put in operation in the USSR Central Statistical Administration. All this affirmed the authority of the institute and brought it deserved acknowledgment.

In 1963 F. T. Sarkisyan, now chairman of the Council of Ministers of the republic and academician of the Armenian SSR Academy of Sciences, became director of the YerNIIMM. Upon his initiative large-scale sicentific-technical and production measures were carried out,measures directed toward expansion of the set of themes of the institute, improving the quality of developments and increasing capacities. This also laid the foundatation for a new stage in the growth and development of the YerNIIMM.

In a short time second-generation computers were developed--the "Masis," "Araks," :Razdan," "Nairi," "Dven," "Marshrut," etc. A special place in the developments is occupied by the universal computer "Razdan-3," the ancester of the "Nairi" family of small computers and the "Marshrut" computing system.

The development of the first representative of the "Nairi" family of small computers started in 1962. This laid the foundation for a new direction of small computers in the YerNIIMM. A distinctive feature of this machine is the fact that for the first time in the Soviet Union the principles of microprogram organization of control and automatic programming were applied in computers, and this permitted sharply simplifying operation of the machine, reducing its size, increasing its reliability and making it accessible to a specialist in any area of science and technology.

Later the original microprogram structure and the built-in system of programming were protected by a number of author's certificates and the structure of the basic "Nairi" computer was patented in England, France, Italy and Japan.

Implementing the long-term complex program of socialist economic integration, in 1969 the countries of socialist collaboration concluded an agreement on scientific and technological collaboration in the area of developments and the production of computer hardware. In this way efforts were combined for the creation of the YeS computer.

The YerNIIMM was entrusted with honorable and difficult work--the development of one model of the YeS computer--the YeS-1030. In 1971 the YeS-1030 was successfully transferred to the state commission. The machine completely satisfied all the requirements of the YeS "Ryad-1" computers.

The institute was entrusted with the development of the YeS-1045 (chief designer, A. Kochukyan) and in December 1978 the machine also was presented for state tests.

The commission for conducting state tests of the prototype of the YeS-1045 computer, under the chairmanship of A. Dorodintsyan, accepted the machine with a high rating, notng that it was made on the level of world standards of computer technology. Later, in 1980 an international commission, having subjected the YeS-1045 to thorough tests, noted that it is the most balanced, and in summary criteria of optimality (productivity, memory volume, range of possibilities, reliability and convenience in operation) the machine has no equal.

The YeS-1045 was displayed at the international exhibition "YeS and SM Computer Hardware and Its Application" (at Moscow) and received deserved acknowledgment. It was acknowledged to be the best computer among YeS computers.

Scientific research work on the creation of an automated system for planning radio-electronic apparatus was started in the YerNIIMM in 1970. The development of that system was completed and has been functioning in practice since 1975.

The computer hardware and control systems developed in the YerNIIMM has been marked by a Lenin Prize, state prizes of the USSR and Armenian SSR and Leninist Komsomol prizes, has been demonstrated at various domestic and foreign exhibitions and fairs and has everywhere earned high awards.

For results attained in the development of our country's computer technology a large number of scientific associates of the YerNIIMM and its experimental plant have been awarded orders and medals of the USSR, and the institute--the Order of the Red Banner of Labor.

In examining the path that has been travelled by the institute and experimental plant it is necessary to give their due to all who have created the history of the YerNIIMM in the course of the 25 years--the workers and employees and the party, trade-union and Komsomol organizations that have made an enormous contribution to the matter of the establishment and development of the institute. It is the labor biography of a glorious collective. A path has been travelled in which our institute can deservedly be proud. On that entire path enormous attention has been given to the institute by the Central Committee of the Communist Party of Armenia and the government of the republic. Thanks to that help the scientific research institute has grown into a large scientific center in the area of electronic computer technology and control systems.

2174
CSO: 1863/31

DORODINTSYN PRAISES YEREVAN SCIENTIFIC RESEARCH INSTITUTE OF MATHEMATICAL MACHINES

Yerevan KOMMUNIST in Russian 23 Oct 81 p 2

[Article by A. Dorodintsyn, director of the Computer Center of the USSR Academy of Sciences, academician]

[Text] I congratulate the collective of the Yerevan Scientific Research Institute of Electronic Computers on their glorious jubilee. Twenty-five years--that is the history of computer technology of the Soviet Union. The collective started its remarkable creative work from the first years of that history and made a decisive and original contribution to the development of our country's computer technology.

The "Radyan-2" was the first semiconductor electronic computer that went into series production. The "Nairi" system of computers--the YeS-1045, an original creation of the YerNIIMM, is the best machine of the YeS basic series of computers. The first matrix processor, which marked the new contemporary stage in the development of electronic computers, was created by developers of the institute. Not copying, but a search for its own original solutions--that is a characteristic feature of our glorious jubilarian.

Electronic computers bearing the Yerevan mark enjoy wide renown not only in our country but beyond its borders. There is always a great demand for them.

Once more accept my congratulations and best wishes for great success in your future creative work on the most decisive section of the front of scientific and technological progress.

2174
CSO: 1863/31

RELATIONS OF YEREVAN SCIENTIFIC RESEARCH INSTITUTE OF MATHEMATICAL MACHINES WITH ESTONIAN COMPUTER CENTER

Yerevan KOMMUNIST in Russian 23 Oct 81 p 2

[Article by Yuriy Malsub, director of the Republic Computer and Data Processing Center, Estonian SSR Ministry of Communications]

[Text] Armenia--"Nairi"--Estonia. This is one of the relations between the two republics, and specifically, between the YerNIIMM and the Computer Center of the Estonian SSR Ministry of Communications, which has already existed 10 years.

The first mission went to Armenia in September 1971 and made personal contact with the chief designer, Grach'ya Ovsepyan.

Already in 1972 the "Nairi-3" computer, thanks to microprogramming, directly tested the quality of communications. Developments of hardware were minimal in that case. At the same time a rather bold decision was made: to expand by their own efforts the "Nairi" computers to the configuration "Nairi-3-1." At that time they still were not produced. Thanks to the personal initiative of the former chief engineer of the experimental plant, Armand Uutmaa, we succeeded in acquiring the necessary apparatus components. In the fall of 1974 a new computer was able to say "Good morning" to us--the "Nairi-3-1" emulator.

Scientific and technological collaboration was thus started. On the one hand, experienced specialists under the leadership of Aram Geoletsyan, and on the other, young, still "green" Yulo Ryatsen, Tiyt Kirss, and others. Contract relations have brought us great experience and expanded the rich software of computers of the "Nairi-3" series.

The capacity of our computer center will grow. And that means that the relations with the institute will become much closer.

2174
CSO: 1863/31

PERSONNEL OF YEREVAN SCIENTIFIC RESEARCH INSTITUTE OF MATHEMATICAL MACHINES PRAISED

Yerevan KOMMUNIST in Russian 23 Oct 81 p 2

[Article]

[Text] A quarter of a century. By this time the collective has reached maturity, completely manfested its scientific and productive potential and made its claims on the future.

Our discussion is of the people of YerNIIMM, about those who created the insitute and are responsible for its reputation today, about the young engineering generation which is solving the very important problems posed by the 11th Five-Year Plan.

"The oldest among us was the director and he was not much more grown-up than we were. At the cradle of the Yerevan Scientific Research Institute of Mathematical Machines (Yerevanskiy nauchno-issledovatel'nyy institut matematicheskikh mashin--YerNIIMM) stood Corresponding Member of the USSR Academy of Sciences, Academician of the Armenian SSR Academy of Sciences Sergey Nikitovich Mergelyan. The VUZ's of the republic had not prepared the necessary specialists. We had a very rough idea of computer technology. We still did not know how to approach its creation, but we were daring!" recalls Arman Takvorovich Kuchukyan, section chief, chief designer, twice laureate of a State Prize of the Armenian SSR, cavalier of the Order of the Red Banner of Labor. "After probationary work at the Moscow Higher Technical School imeni M. E. Bauman we began to make our first timid steps..."

In the course of that work workers with clear logical thinking, high intellectual gifts and distinctive organizer capabilities were revealed. Collectives formed around them. And they, the main developers of themes, not only "tossed off" ideas but also by their own example provided enthusiasm in the most difficult periods of research. One of the leaders is section chief Garnik Ovsepovich Patvakanyan. His colleagues say that there are not many such specialists on computer channels. "And this is one of the most critical computer hardware, with a complex algorithm of its functioning, figuratively speaking, the "spinal cord" of the computer.

Genrikh Grigor'yevich Belkin has been working in the institute since the day it was founded. When they speak of engineers by vocation, they mean such as he. A specialist of high erudition, with a certain sixth sense with respect to avoiding errors. Viktor Melik-Parsadanyan, Rudol'f Oganyan and Avetis Berberyan made large contributions to the creation of an automated system for the Moscow rail junction, the largest in the country.

The collective of developers, without changing much in its composition, studied the YeS-1030 computer. A task arose, that of maximally unifying and standardizing the technical solutions and the programming language. Mirgan Aramovich Semerdzhyan and Arman Takvorovich Kuchukyan were the chief designers of the YeS-1030, Levon Gasparyan the assistant for architecture and Ashot Bagdasaryan the leading mathematician. The work was crowned with success. A large series of computers was shipped to Czechoslovakia and Bulgaria, Hungary and Poland, Mongolia and India. Two gold and seven silver and bronze medals were received by the developers at international exhibitions.

The powerful monitoring and diagnosis system of the YeS-1045 computer was provided by the laboratory of Igor' Mkrtumyan, and much was done for its development by the deputy chief designer, Candidate of Technical Sciences Tomir Isayevich Sarkisyan.

Engineers have a surprising psychology: engaged in state assignments, they press their stressed plans, but if an original idea arises here, the people work 24-hour days to prove its viability! And still more stressed plans and compressed periods prove to be within their power. Thus the YeS-2345 matrix processor arose "initiatively" (section chief Levon Gasparyan, assistant for design Lazar' Martirosyan, electronics Levon Grigoryan and Levon Gasparyan, mathematician Zhanna Nalbandyan and technologist Edvard Manucharyan). A state commission headed by Academician A. Dorodnitsyn accepted the new item with a high evaluation. Whereas the YeS-1045 itself performs 880,000 operations per second, when paired with the new processor it performs 30 million! And, forming with the machine a third of its generation, the YeS-1030 in solving a very complicated geophysical task, in tandem took a total of 10 seconds instead of 5000 seconds.

"With us one can become a specialist by proceeding through the stage of developing even one machine," they say in the institute.

The leading subdivisions of YerNIIMM make selections to replenish their personnel among students of the third and fourth classes, not from the VUZ graduates. In the Institute of Mathematical Machines the children spend the time in practice, make themselves comfortable and write diploma works. Their further fate, as a rule, is connected with that institution.

The average age of a YerNIIMM worker is 29 years. Vagan Gonchoyan had the usual fate: from practicing student to candidate of technical sciences and sector chief.

"Here the work is like a father to me; I came to it from the fourth class," says Gonchoyan. "There has traditionally been a strong school of small computers and microprogramming in the YerNIIMM. I also wanted to specialize in that area; I became acquainted with the technology on the 'Razdan-2' and 'Nairi-1' computers. I won the title of Leninist Komsomol Prize laureate for developing the 'Nairi-3.' My colleague," he continued, "sector chief Gagik Grachyan, started with the 'Nairi-4' and was awarded the title of Leninist Komsomol Prize laureate.

Many of those who were yesterday's graduates have become class specialists: chief engineers Ernest Zakaryan and Viktor Kikot' and engineers Eduard Chalakhyan, Grigoriy Troyan, Gagik Zhamkochyan, Sergey Panfilenko, Sergey Taranukha and Varsham Khlgatyan.

2174
CSO: 1863/31

PUBLICATIONS

ABSTRACTS OF ARTICLES FROM JOURNAL 'CONTROL SYSTEMS AND MACHINES', JULY-AUGUST 1981

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 4, Jul-Aug 81 pp 145, 147, 149, 151

UDC 681.3.06

PROBLEMS OF CONTRUCTION OF RECURSIVE DATA STRUCTURES

[Abstract of article by Aleksandrov, V. V., Arsent'yeva, A. V., and Gorskiy, N. D.]

[Text] The creation of a data base in which the data structure is not declared a priori but is generated in the process of feeding data into a computer is discussed. A method is proposed for associative storage and access to information on the basis of representation of the data structure in the computer memory by means of recursive procedure.

UDC 681.3.06

PLANS OF HETEROGENEOUS DATA BASE INTEGRATION SYSTEM

[Abstract of article by Kalinichenko, L. A., and Chaban, I. A.]

[Text] The authors present the main results obtained in planning a heterogeneous data base system assuring applied program independence from a data base management system (DBMS) and their simultaneous interaction with many data bases organized by means of various DBMS. The plan opens up the way to the creation of distributed data processing systems based on computers of various types (primarily YeS and SM computers) in which the necessary applied program of information extracted from data banks of various types becomes available through one inquiry in a high-level language.

UDC 681.3.06

PROBLEM OF INDEPENDENCE OF DATA AND ITS SOLUTION IN THE PAL'MA DATA BASE MANAGEMENT SYSTEM (DBMS)

[Abstract of article by Bakayev, A. A., Kramarenko, R. P., and Kostruba, T. V.]

[Text] The need for a layered architecture for a DBMS is substantiated from the point of view of assuring the main requirement--independence of the data. Necessary and sufficient conditions are presented for solution of the problem of independence and the mechanism of multilevel representation within the PAL'MA DBMS is examined.

UDC 681.3.016:519.876.2

DATA BASE DESIGN BASED ON A RELATIONAL LATTICE MODEL OF AN OBJECT AREA

[Abstract of article by Krakht, V. A., and Rootalu, E. P.]

[Text] A method is proposed for data base design covering all main design phases from the conceptual modeling of an object area to the specification of a local structure of the data base. A relational lattice model of the data base is defined and the possibility of constructing the integral data base design method on the lattice model is shown.

UDC 683.3.016

GENERALIZED PROCEDURES OF COMPUTER-AIDED LOGICAL DESIGNING OF DATA BASES

[Abstract of article by Savinkov, V. M., Veynerov, O. M., and Kazarov, M. S.]

[Text] Questions in the automation of logical data base design are examined. Criteria of the logical design quality plan are substantiated. A generalized procedure of logical data base synthesis is proposed, one based on the synthesis of relations of the fourth normal form. Recommendations of representation of normalized relations on the model of data of specific data base management systems are formulated and exemplified.

UDC 681.3.053

AUTOMATION OF DATA BASE PLANNING. GENERAL ANALYSIS OF THE PROBLEM

[Abstract of article by Mikhnovskiy, S. D.]

[Text] The state of development of the problem of automation of data base designing is surveyed and analyzed from the point of view of attainment of two main final results: development of processes of data base designing and the construction of a system to automate those processes.

UDC 681.3.06:681.2

MEASUREMENT CHARACTERISTICS OF NUMERICAL DATA IN THE DATA BASE OF INFORMATION-MEASUREMENT SYSTEMS FOR THE AUTOMATION OF PHYSICAL EXPERIMENTS

[Abstract of article by Malashinin, I. I., and Zhuk, V. I.]

[Text] It is shown that the measurement characteristics of numerical data, of the results of measurements, ought to be taken into consideration in the manipulation of data in data banks. It is proposed to indicate those characteristics, which include units of measurement, errors, scale models, characteristics of quantization and interpolation in the circuit of a data bank maintained by a data bank management system oriented toward application in information-measurement systems.

UDC 681.3.06:658.5.011

EXPERIENCE IN USE OF THE 'OKA' DATA BASE MANAGEMENT SYSTEM (DBMS) IN DEVELOPING A PRODUCTION DESIGN-TECHNOLOGICAL PREPARATION SUBSYSTEM

[Abstract of article by Rudenko, R. V., Ellanskaya, L. V., Bakhchisaraytseva, N. B., Narinyan, A. R., and Golodnitskaya, Z. A.]

[Text] The authors examine problems relating to the development of a production design-technological preparation subsystem based on the "OKA" DBMS for a computer-aided machine-building enterprise management system. A list of problems solvable in the subsystem is given and the real-time indicators are presented.

UDC 681.31

RELIABILITY OF COMPUTERS WITH NON-CANONICAL DATA BASES DEFINED BY NATURAL REDUNDANCY OF POSITIONAL NOTATIONS

[Abstract of article by Bryukhovich, Ye. I.]

[Text] The results of investigation of the influence of non-traditional data bases of computer hardware on the reliability of single-chip computer devices are presented. It is shown that this reliability is practically the same as that of devices using traditional data bases.

UDC 681.327.023

SOME FUNCTIONS AND STRUCTURES OF INTELLIGENT INFORMATION FORM CONVERTERS

[Abstract of article by Yeremeyev, I. S., and Kondalev, A. I.]

[Text] The prospects of development of a new generation of information form converters, intelligent converters, are described, together with a spectrum of problems they solve. Stages of converter synthesis (choice of procedures and hardware, software and structures) as well as the problem of fail-safety are discussed.

UDC 681.3.06.4

DISTINCTIVE FEATURES OF THE ARCHITECTURE AND STRUCTURE OF A PROBLEM-ORIENTED BASIC COMPUTER FOR PROCESSING DATA OF FULL-SCALE TESTS

[Abstract of article by Korniyenko, G. I.]

[Text] Distinctive features of the development of the architecture and structure of a basic computer for full-scale test data processing are examined. Problems of architecture-structure interrelationships, hardware expenditure ratios, general organization of the computer, including features of construction of the processor, memory and input/output subsystem, are discussed.

UDC 681.032

SYNTHESIS OF CONTROL DEVICES WITH VARIABLE TIME DIAGRAMS

[Abstract of article by Ordyntsev, V. M.]

[Text] A method is suggested for construction of control devices for scientific research automation systems with several modes of operation which differ in their time diagrams of control signal generation. The structure of the control devices is based on the use of two types of special flip-flops which are subjected to signals which set the required mode of operation of those devices.

UDC 621.374.32:681.326

USE OF TIME REDUNDANCY TO SIMPLIFY BINARY COUNTER CHECKING

[Abstract of article by Grol', V. V.]

[Text] The author examines the possibility of reducing the complexity through use of the natural time reserve for a checking method based on prediction of the parity of the following state.

UDC 681.3.008

ANALYSIS OF EXCHANGE PROCESSES IN A DIRECT MEMORY ACCESS MODE

[Abstract of article by Fedorovich, O. Ye., and Gerbali, S. N.]

[Text] Conflict situations arising during processor-channel interaction in a direct memory access mode are evaluated. The investigation was conducted in a sufficiently wide range of variation of the time characteristics of individual devices controlling the computing comples on the basis of the developed simulation program package.

UDC 681.327

A METHOD OF ORGANIZING DATA PROCESSING IN CONTROL SYSTEMS

[Abstract of article by Badanin, V. P., Zhmel'ko, A. N., and Lobanon, L. P.]

[Text] A method is proposed for the organization of data processing in control systems, a method which takes into account the dynamics of arrival of incoming messages. The dynamics is taken into consideration by the formation of an input package of messages in each interval of system functioning.

UDC 681.327.64

SOME METHODS OF DIGITAL MEASUREMENT DATA RECORDING ON A SINGLE-TRACK MAGNETIC MEDIUM

[Abstract of article by Sevast'yanov, A. K.]

[Text] A classification is presented for certain methods of digital recording of measurement data on a single-track magnetic medium and their positive and negative properties are described. Alternative structural circuits are examined and the preferential area of their application pointed out. The structures considered can be used in digital transmission of experimental data over a two-wire line of communication.

UDC 658.012.011.56:681.3.06

USER-ASU INTERACTION LANGUAGE

[Abstract of article by Kondrat'yev, V. V., Mal'tsev, V. N., Reshetov, M. V., and Khaberev, N. P.]

[Text] Principles of organization of user-ASU interaction on the basis of an expanded interaction language are proposed. These principles are illustrated on the example of interaction of a technologist-foreman with a complex ASU for integrated circuit and large-scale integrated circuit assembly.

UDC 681.327.6

PROGRAM-TECHNOLOGICAL SYSTEM OF DATA INPUT AND VERIFICATION IN ASU

[Abstract of article by Granaturov, V. M., Karnal', V. A., Glagolev, Yu. M., and Vinogradskiy, I. V.]

[Text] The authors examine the concepts and structure of a program-technological system of primary data processing determing the data processing technology and the technology of production of the corresponding programs. The system automatically stores data for analysis of the quality of data processing and is realized in YeS operating system and disk operating system with a standard set of peripherals.

UDC 681.3.04:658.5.011.56

SELECTION OF A SYSTEM FOR CODING TECHNICAL-ECONOMIC DATA IN AN ASU

[Abstract of article by Burd, B. V., and Litver, L. V.]

[Text] A criterion is proposed for selecting a system for coding technical-economic data, one supplementing general system criteria used earlier. A method of selecting the coding system according to the described criterion is presented. The advisability of using the proposed criterion in selecting a system for coding technical-economic objects in an ASU is shown.

UDC 62-52:681.3.06.2

METHOD OF FILE HANDLING IN AN AUTOMATED ENTERPRISE MANAGEMENT SYSTEM

[Abstract of article by Rozenblyum, L. V., and Trembovol'skiy, B. L.]

[Text] The authors describe a method of data compression for the arrangement (packaging) of the main files of an automated enterprise management system data base in the immediate-access memory. The method is based on subdivision of the files into several parts and the organization of address references between them. Estimates of the effectiveness of the method according to the volume of the occupied memory are presented.

UDC 681.31

REVIEW OF OPTIMIZATION PROCEDURES

[Abstract of article by Arkhangel'skiy, B. V.]

[Text] A set of optimization procedures is described which convert non-optional constructions which occur in the programs of even experienced programmers. The procedures are oriented mainly toward programs written in high-level languages. The described set includes procedures which optimize zones and index expressions.

UDC 681.3.06/94

SOFTWARE OF AN M6000-AIDED POSITION OF A MICROPROCESSOR PROGRAMMER

[Abstract of article by Savat'yev, B. A., Bobovskiy, V. V., Zhiginas, S. A., Kotlinskiy, L. I., and Serdyukova, S. A.]

[Text] The organization of software of an automated programmer's position based on the M6000 computer is examined. Possibilities offered a programmer by it in developing microprocessor programs are discussed. An algorithm of input-output system simulation and of microcomputer interruptions is described.

UDC 681.3.06

ANALYSIS AND SYSTEMATIZATION OF BUILT-IN PROBLEM-ORIENTED SYSTEMS

[Abstract of article by Bezhanov, M. M.]

[Text] Characteristics and methods of construction of built-in problem-oriented systems are examined. The basic principles of the methodology for the creation of such systems and their source languages are established. The methodology can be used in creating problem-oriented systems for various purposes and serves as the basis for constructing integrated systems.

UDC 681.3:658.56

SOME POSSIBILITIES OF ANALYTICAL CONVERSIONS IN THE SPOK-VUZ SYSTEM

[Abstract of article by Kirova, K. N., and Smirnov, V. P.]

[Text] The possibilities of the SPOK-VUZ interactive learning system for analytical polynomial onversion are examined. The mechanism of connection of applied user programs on the level of external dynamic functions is described. A classification of modules of SPOK-VUZ packages of applied programs accomplishing conversions and an example of their use are given.

UDC 62-52:681.3.06.44

EXPERIENCE IN THE DEVELOPMENT OF A COMPUTER-AIDED LEARNING COURSE FOR USERS OF DATA BANK CONTROL SYSTEMS

[Abstract of article by Gernega, I. B., Davydov, V. I., Zhukovskiy, M. V., and Lozovatskaya, A. A.]

[Text] Methodical principles and practical recommendations are presented on the realization of computer-aided learning courses in the system of programming YeS SPOK learning courses. Characteristics of the computer-aided course, "Introduction to data base control systems," developed at Odessa Polytechnic Institute, are presented.

UDC 681.3.004:658.512.2

METHOD OF ANALYTICAL-EXPERIMENTAL OPTIMIZATION OF MACHINE-BUILDING PRODUCTS

[Abstract of article by Golev, R. V., Konovalov, A. A., and Kudrin, V. G.]

[Text] A method is proposed for analytical-experimental optimization of the quality characteristics of machine-building products with intrastep identification of a mathematical model by its dynamic characteristics. Mathematical and experimental methods of optimum planning and engineering development are combined in a single iterative process.

UDC 621.397:681.322

PLANNING THE TOPOLGY OF SUBSCRIBER DATA TRANSMISSION NETWORKS WITH CONCENTRATORS FOR MULTIPLE-ACCESS COMPUTER CENTER NETWORKS

[Abstract of article by Zaychenko, Yu. P., and Kondratova, L. P.]

[Text] The general task of synthesizing data transmission networks with concentrators for an arbitrary number of levels of concentration is formulated. A standardized algorithm is proposed for its solution, one which takes into consideration various limitations of the task as a result of use of communication channels and concentrators of different types. The algorithm is investigated experimentally, its characteristics determined and its effectiveness estimated.

UDC 681.3.06

PACKAGE OF APPLIED PROGRAMS TO SOLVE UNCONDITIONAL MINIMIZATION PROBLEMS

[Abstract of article by Antonyuk, A. A., Bulanyy, A. P., Danilin, Yu. M., and Redkovskiy, N. N.]

[Text] A package of applied programs is described, one intended for the solution of unconditional minimization problems. Highly efficient and convenient algorithms developed by the authors are used in the package, and also some widely known algorithms. The package is in FORTRAN for the BESM-6.

UDC 681.3.06.068

STRUCTURE OF OPERATING SYSTEMS OF COMPUTER COMPLEX FOR MACHINE-TOOL CONTROL

[Abstract of article by Krasilov, A. A., Gorel'kov, A. L., and Odintsov, A. V.]

[Text] The structure of hardware and software of a system for control of a wide spectrum of machine tools, consisting of three "Elektronika-60" computers, is examined. Four real-time operating systems are realized in the system. They execute the functions of interaction with the technologist-programmer, form and issue control actions, analyze the states of hardware and indicate the parameters of the finishing of parts and the statistical processing of downtime. Methods of adapting the operating systems to the configuration of the equipment are indicated.

2174
CSO: 1863/11

- END -

END OF
FICHE
DATE FILMED
6 Jan 1982